REPORT RESUMES

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THE IMPACT OF NEW MEDIA ON EDUCATION AND THE SOCIETY.
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A VOLUME OF ESSAYS WHICH SPECULATED ON THE ROLES THAT MAY BE PLAYED BY NEW EDUCATIONAL MEDIA IN THE AMERICAN SOCIETY HAS BEEN COLLECTED. THE VOLUME CONSISTS OF 5 PARTS AND 11 CHAPTERS. IN PART ONE, "OVERVIEW," THE EDITORS HAVE SUMMARIZED AND SYNTHESIZED THE ITEMS IN THE COLLECTION, AND ADDED THEIR OWN SPECULATIONS ABOUT THE IMPACT OF NEW MEDIA OVER THE NEXT FEW DECADES. OTHER PARTS OF THE COLLECTION ARE (1) RECENT AND PROJECTED TECHNOLOGICAL DEVELOPMENTS, (2) IMPACT OF NEW MEDIA ON SCHOOL SYSTEMS, (3) IMPACT OF NEW MEDIA ON OTHER ASPECTS OF AMERICAN EDUCATION, AND (4) GENERAL IMPLICATIONS FOR AMERICAN SOCIETY. (JC)

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Edited by

Bruce J. Biddle and Peter H. Rossi

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March, 1965

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PART I

OVERVIEW

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CHAPTER I

EDUCATIONAL MEDIA, EDUCATION, AND SOCIETY

Bruce J. Biddle
and
Peter H. Rossi

The contributions to this volume were designed to be essays in speculations on the roles that may be played by the new educational media in the American society of the next few decades. As editors of such a volume there are several courses of action open to us. We can choose the coward's path and say nothing about the items in the collection. Or, we can attempt a summary or synthesis. Or, we may attempt to correct the errors of omission and commission made by the several contributors. We have chosen to do all of these things and, in addition, to add our own speculations as well.

Our aim here is reasoned and reasonable social science fiction. Many of our "hunches" will appear to be unsupported; indeed, contrary to our academic predilections, this essay is presented without scholarly references, except for those to the other selections in this volume. Not all the predictions made here will necessarily come about. Our aim is to provoke thought, to raise questions, and to stir up interest in developments and problems of the uses of new media in education.

The essay is organized into five parts: The first is this "Overview." The second deals with the concept of an educational medium and types of media. The third takes up the problem of the adoption of media in education. The fourth discusses media impact on education. The fifth is concerned with the impact of educational media and education on Western society.

The Concept of an Educational Medium

A striking variety of devices has been claimed as educational media at one time or another including television, books, maps and globes, visual aids, language laboratories, teaching machines, chalk boards, and even pencils, papers, desks, lighting, or subject matters. In addition, the majority of those devices which we are fairly certain are "really" educational media (such as television, books, or visual aids) may be found both within and outside of educational contexts. How, then, are we to decide what things are and are not educational media? What are the peculiar properties of this genus, and how do those properties relate to the problems of media impact?

For our purposes a medium may be defined as any form of device or equipment which is normally used to transmit information between persons. Thus, radio, television, newspapers, billboards, letters, handbills, books, teaching machines, and all such devices are media by this definition. An educational medium is such a device used for educational purposes. Thus, when television is used for education (rather than for entertainment or for other goals), it becomes an educational medium whether found in the home, tavern, or school. By convention, we are also apt to think of as educational those media which are found in a school context, whether they are used for education or for other purposes. Television and radio sets found in schools are usually assumed to be educational media, even though they may sometimes be used for entertainment.

This definition has several implications which are worth spelling out. First of all, it is the use to which a device is put that makes it a medium. By themselves a stretch of smooth sand and a stick do not convey information. One may, however, draw in the sand with the stick whereupon a medium is created. A similar case may be made for the chalk board. By itself, this device conveys no information. Indeed, it can be used for many non-informational activities such as discipline (the writing of a lesson "100 times"), cleaning up, or light and sound control. Another way of making this point is to suggest that devices are never media in and of themselves. They become media only when associated with those peculiar processes of human behavior which we have termed the transmission of information.

At a minimum, information transmission through media involves two types of human activity--encoding and decoding. Encoding consists of those activities engaged in by the communicator of the message which place information upon the medium. Examples would be the processes of writing upon a chalk board, drawing a picture, or producing and acting in a television program. Decoding are those activities engaged in by the user of the message who takes information from the medium. Examples are those of reading, listening, watching, "cutting the pages" of a book, and so forth. Most media are so arranged that the activities of decoding are made as easy as possible, thus the role of the user is usually more passive than the role of the communicator.

Although certain simple media consist of but single devices (for example, a megaphone), the majority of media are systems with at least several component parts. Even a chalk board, for instance, cannot be considered a medium until we have another device for writing upon it--chalk. When we turn to recent innovations in media, one is impressed with their enormous complexity. A language laboratory consists not only of the microphones, booths, and desks of the immediate system, but also of the carefully-prepared instructional tapes, circuitry, and methods of language instruction with which it is associated. By itself, a television set cannot constitute a medium. It becomes a medium when associated with a broadcasting system, writers, producers, actors, news gatherers, transmission lines, and all the accoutrements of modern network production. Such media are not only complex in terms of "hardware," they also involve complex patterns of social behavior, differentiated positions, and roles.

Finally, since educational media differ from media-in-general in terms of educative use, we suggest that one can, in fact, differentiate educative uses from other forms of use. In practice this is often difficult to do. Let us take merely those forms of behavior carried on within an educational institution. Particularly in small communities, a consolidated school may serve not only educational ends but may also be used for baby sitting, recreation, a local meeting house, the focus of community pride, a major source of revenue and economic support, a creator of jobs, a locus of political power or controversy. Clearly these latter forms of behavior are not educative, although they bear relationships to educational activities. Media used, for instance, to transmit information for recreational purposes (for instance, a basketball scoreboard) are not educational in any strict sense.

Similarly, contemporary society is characterized by a diversity of educational settings. Formal (classroom) education proceeds in schools, churches, factories, summer camps, and in the armed forces. Informal education is found nearly everywhere, in homes, offices, stores, airline terminals, and on street corners. Education in any of these settings may involve media, but we would only term them educational media if their primary use was educative. For instance, although the motion picture theatre may be used for education, its normal function is entertainment. Contrast this with encyclopedia or privately-owned teaching machine whose use is primarily educative.

These observations suggest a definition. For our purposes, education may be considered as those activities wherein the learning of one or more persons is being deliberately controlled by others. Education may be restrictive (socialization) or expansive (the encouragement of creativity). It may reflect a variety of strategies including practice, information transmittal, or discussions of thinking itself. It may be formalized and ritualized, or informal and sporadic. However, wherever education takes place, there are always two recognizable roles--those of teacher and student. Educational media are those used to support the processes of education, whereby teachers attempt to induce learning in students.

New Media and Other Forms of Technological Innovation

Media are devices, and the appearance of a new medium always constitutes a technological innovation. In this sense, the discovery of radio or television is as much an innovation as the discovery of steam, the motor governor, or atomic energy. Technological innovations affect society changing the forms of a national society, affecting community life and organized forms of behavior represented by our major institutions. Technological innovations affect social systems. Educational media, however, have particular types of effects.

Technological innovations often create new roles in social systems. New roles are established concerning the production and maintenance of the new devices. In some cases, whole new industries and professions are created. Consider the railroad. The appearance of this innovation created new corporations, jobs, industries, private fortunes, ways of life. Chinese and Irish immigrants were imported to lay tracks. Special laws were passed. New unions sprang up. Manufacturing, maintenance, and scrapping facilities were created that had not previously existed. In part, this same process may be expanded to apply to such innovations as the automobile, the airplane, the motion picture industry, and television. It is conceivable that the cybernetic revolution (the appearance of computers and robotic control) will obviate repetitive roles in other industries, but the computer and control industry itself shows a predictable tendency toward greater complexity and the appearance of new roles defined in terms of the innovation.

New roles are confined primarily to the invention, production, and maintenance of an innovated device. When one turns to device utilization, a different pattern emerges. The appearance of most technological innovations leads to a simplification of the life of the user. For instance, the automobile allows the user to spend less time and energy in transportation (at least under optimum conditions); the home appliance allows the housewife to complete her home-making chores with less effort; the new duplicating machine simplifies and makes office routines less expensive. Thus, the effect of most technological revolutions on the user is to reduce the drudgery of his life, to increase his leisure time, or to allow him to do other things...Indeed, it is this simplification of life that leads most users to desire and adopt new devices.

This generalization does not, however, apply to new media. Since media are defined as devices which transmit information, the use of a medium does not free time; it fills time. The use of television does not simplify life for the user; it complicates life. After watching the "idiot box," a housewife is no further along on her housework, although she may be in a better mood and is almost certainly more informed than she was before. If media do not simplify life, if they do not increase leisure time and allow the user to do what he wants to do, why then are media adopted as innovations? The answer would appear to be--to fill time. The media user chooses to watch television or listen to the radio rather than do "nothing," engage in sports, or seek additional employment. It is impossible to imagine much media use in a society where all persons were employed sixteen hours a day in labor. It is the appearance of leisure time that allows media use. And media fill the vacuum left when other forms of technological innovation free the user from life's drudgery. We shall return to this peculiar, time-filling property of media in the final section of the essay.

There is another peculiar property of media which also set them apart from other innovated devices. Because media provide information for the user, media tend to enlarge the horizons of the user, tend to make of him a larger, better informed, less satisfied person. Contrast the user of the newly-invented machine tool with the user of the newly-invented television set. The former is provided with a much faster and more accurate way of getting his job done. He can therefore produce more work (and get higher pay) or may have greater leisure time. But nothing has happened to his horizons.

He does not necessarily know another thing about his neighbor than he did before. If he chooses, he may spend that additional money or leisure time in private pursuits, such as fishing or drinking beer or carpentering around his house, and never learn any additional information other than that involved in operating the new device itself.

By way of contrast, the user of television has considerable difficulty avoiding contact with other ways of life. It is certainly possible for him to tune, selectively, to programs that fit his political pursuasion or recreational interests, but it is difficult for him to avoid all contact with other parts of the country or the wider world. Thus, Negro users become aware of the deprived conditions under which they are living, and Americans become aware of Europe or underdeveloped portions of the world. Media, thus, have a direct impact on users--that of enlarging horizons.

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Types of Media

Media differ from one another along various dimensions. Some of these bear relevance for the understanding of media impact. Thus it is useful to examine media dimensions and to exemplify types of media at various points along them.

Literacy. Some forms of media, such as books and teaching machines, require that the user be able to manipulate and understand symbols--in short, that he is literate. Other media forms, such as television and motion pictures, may be understood and appreciated by illiterate and literate users alike. Perhaps because of our familiarity with books and the centrality of reading and writing skills in educational practices, we normally think of educational media as requiring literacy. However, some media do not require literacy, and their intensive use may possibly interfere with the acquisition of literacy habits and skills. On the other hand, appropriate use may also be made of non-literate media to inform non-reading users (such as residents of an underdeveloped region) or to stimulate interest in literacy among those whose motivation would otherwise be low (such as those reared in slums).

Audio and Visual. Commonly available media make primary use of two sense modalities, seeing and hearing. Some media, such as disc and tape recordings, involve only audio information. Other media, such as books and visual aids, are solely visual. Finally, some media, such as television and motion pictures, make use of both modalities. Various proposals have been advanced for the creation of media that would provide tactile, olfactory, or taste information, but nothing has come from these proposals to date.

There is a relationship between the literacy requirement of a medium and the probability of its being audio or visual. This relationship is most easily seen in Figure 1. Note that many examples may be found of media that are visual and require literacy, that are visual and do not require literacy, and that are audio and do not require literacy. It is difficult, however, to find even a single example of a medium that is audio and that requires literacy.

Static and Dynamic. A related phenomenon is the static or dynamic quality of the medium. This property may best be illustrated by considering the difference between a motion picture film and a filmstrip. The former portrays a continuous sequence of events, a sequence of visual portraits whose presentation is so fast that the user has the illusion of continuous presentation. The filmstrip, in contrast, is stochastic. The presentations are discrete; they do not flow; the record is static. Other

Media Sense Modality

Media User Requirements

	Audio Only	Visual Only or Visual plus Audio
Requiring Literacy		Teaching Machines Books Chalk Boards Visual Aids
Not Requiring Literacy	Disc Recordings Tape Recordings Language Laboratories	Television Motion Pictures Film Strips

Figure 1: Media sense modality and user requirements.

Degree of User Control

Degree of Communicator Control

	Low	Flexible	High
High	Early Teaching Machines Chapter Hand-Outs	Contemporary Teaching Machines Textbooks	Book shelves
Flexible		Paper-back books	Reprints
Low			Libraries

Figure 2: Types of media in terms of communicator and user control.

examples of both static and dynamic media may easily be found. Audio recordings are usually dynamic, although those associated with language laboratories may be static. Television is dynamic; books and chalk boards are static. The advantage of a static medium is that it allows intensive and analytic study. A complicated discussion of a mathematical equation may be gone over intensively until the user comprehends it. The advantage of the dynamic medium is that it facilitates intuitive and integrative understanding, particularly of those processes which vary over time. The motion picture of an athlete in action, for instance, is often far more useful to him and his coach than equivalent still pictures.

Programming. Media differ over the degree to which they are controlled by both communicator and user of the medium. A television broadcast, for instance, is highly controlled by the communicator. The user has little or nothing to say over what is transmitted to him; his option is confined solely to either paying attention or not paying attention to the program that is broadcast. One may increase his control over the situation by providing alternate channels for him to watch; the greater the number of channels, the greater freedom the user has. (The increase in behavioral choices is probably the greatest single reason for urban living where more television channels, and probably most other choices, exist.) In another example, teaching machines are normally programmed more rigidly than are books. The reader may, if he chooses, read the last chapter of the book first (to find out if the butler did, in fact, commit the murder). He is usually not free to run the last frame of the lesson programmed through the teaching machine until completion of those lessons which precede it.

It would normally be assumed that media control by the communicator and user were inversely related; the greater the communicator control the lesser the user control and vice versa. Actually, this oversimplifies greatly. Given that media are assembled for information transmittal, it is actually quite unlikely that media would appear that were totally uncontrolled by communicating agencies. The only example which comes to mind is the public library where "the widest" possible range of books is provided users to be put to whatever purpose users choose. But even the library is occasionally under attack by citizens who object to the choice of books purchased or the public display of what is considered pornography.

Figure 2 displays some patterns of relationships between communicator and user control, together with selected examples of media. Thus a lecturer who hands out chapters of his new book, one per lesson, is denying control to the user. Provision of a textbook at least allows the users to choose the order of their readings. Provision of a book shelf or set of supplementary readings allows even more user flexibility. With decreasing control by the communicator, we find fewer examples of media.

Solo Versus Group Use. Some media, such as books, are designed in such a way that use by more than a single person at one time is difficult. Others, such as a filmstrip projector, may be used by a small group. Still others, such as a commercial motion picture theatre, may be used by very large groups. As a rule, group-use media make fewer demands upon the user than do individual-use media, although there are exceptions to this rule.

Cost and Spread. Some media, such as newspapers, are extremely cheap. Others, such as computerized teaching machines, are far more expensive.

Actually, there are two media cost figures that should be distinguished. The first, cost per user, establishes the basic expense it will take to install a medium for a given population. The second, cost per medium unit, specifies the absolute amount needed for each unit installation. For instance, the cost of installing a television transmitter is considerable, but if a great many users of this service are anticipated, the cost per user for this medium may be small.

As a rule, the spread of a medium in any social group will vary both as a function of cost per user and depending on whether the medium is designed for solo or group use. All things being equal, expensive media will be adopted only if they may be used simultaneously by many people, while any medium is likely to be more widely adopted if its cost is reduced. Media that have a really wide spread are commonly called mass media, the best examples being television, radio, newspapers, nationally circulated magazines, and commercial motion pictures. Intrinsic characteristics of mass media are those of strong communicator and little user control, low cost to the user, and wide spread of use among the user population.

It has often been pointed out that mass media tend to homogenize a user population. The unscrupulous user of a mass medium has enormous potential for arousing public emotions and the desire for activity. More subtly, mass media have the effect of standardizing accents and forms of discourse. It should not be assumed that all media have these same homogenizing effects, however. Expensive media, such as "hi-fi" sets and teaching machines, will be adopted by only those portions of the user population who choose to spend their money for the medium in question.

User-controlled media, such as home-tape recordings or movies, individualize by their very nature. If homogenization of the user population is to be avoided (and this is a debatable point), mass media may readily be counteracted with the popularization of non-mass media forms.

It is widely noted that mass media must compete with one another for user attention. We not only must choose between several competing television channels but also between whether to watch television, read the newspaper, or listen to the radio. Competition for attention is usually not characteristic of the school-used medium. On the contrary, the user (in this case, the student) is required to use the medium if he is to remain a student of the specified curriculum. This difference in user conditions suggests that standards for judging excellence of a new medium vary depending on whether it is intended for mass or educational use. Mass media must, above all, be popular; educational media, effective. Mass media must gain and hold attention; educational media normally assume attention. Thus, mass media communicators (such as television producers) are often at a loss when asked to turn their talents to the educational realm.

Mechanical Techniques. The last typological distinction we wish to make refers to technique by which a given effect is achieved. This is most easily illustrated by comparison of the portable motion picture projector with the portable videotape recorder. From the viewpoint of the user, these equipment produce nearly identical results. Both show a video and audio signal, and both signals are dynamic. The motion picture projector places its image on a screen, while the videotape unit's signal may be displayed either on a screen or upon a cathode ray tube. Both signals are adaptable to small, classroom group viewing. Both units may be used to display "canned" signals; that is, pre-recorded films or tapes distributed from a central depository. Both may also "take pictures" of local scenes for later local re-viewing. Neither signal is really of high quality, although watching the picture for an hour a day is within reason for the normal user population. Both types of systems are within the budgetary range of an average school.

The mechanical means used for reproduction are the major differences between these two media. In the case of motion pictures, a camera is used to place light images on film which must thereafter be developed. The videotape recorder uses a television "camera" and electronic tape; and, as with audio recordings, the signal may be replayed immediately or the tape "wiped" and reused for another recording. As of this writing, motion pictures are still somewhat cheaper in terms of capital investment; however the videotape system offers considerably greater flexibility and its introduction constitutes an "innovation" that may someday supplant motion pictures.

Similar innovations of mechanical techniques have occasionally had far-reaching consequences for media. The introduction of the rotary press, for instance, sharply decreased the cost of volume printing and made possible the modern newspaper. Continual improvements are constantly being made in such new media as tape recorders. Basic media innovations take place when the media form is first introduced, for instance, the appearance of television during the second quarter of this century. Innovations in mechanical techniques generally improve or cheapen the medium and lead to its wider adoption.

Media Adoption in Education

The first of our predictive tasks is to deal with media adoption in education. We see the adoption of media as one-half of the effect new educational media make upon the institution of education. Media must be adopted to have any effect at all, and the very fact of adoption (or refusal to adopt) is of significance to educator and medium vendor alike. We see media adoption as the result of two sets of factors--characteristics of contemporary education, and characteristics of media themselves.

Characteristics of Contemporary Education

American education is probably familiar to the reader. Nevertheless, it is useful to review several of the "obvious" properties of education because they are true only for America (in contrast, let us say, with other urbanized countries), because they are only recently true, or because they differentiate education from other forms of institutions. This review, however, will focus on those factors having potential for affecting media adoption.

Size. Taken together, education is the largest single institution in the United States. There are at present more than one and a half million active teachers in this country, nearly twenty million full-time and more than twenty-five million part-time and adult students, and thousands of administrators who run the schools. Formal institutions of education include public, private, and parochial elementary and secondary schools; public and private junior colleges, colleges, and universities; trade and technical schools of all kinds; graduate and professional schools; training institutions operated within industry and other institutions; and a host of adult and continuing education services. Altogether, probably 30 per cent of all Americans will participate in one or another form of organized education during the coming year.

In addition to formalized education, informal education takes place in many different settings including camps, churches, recreational settings, the Army, and industry. Americans are also involved in various educational activities overseas which are paid for in this country including the Peace Corps, State Department and Foundation-supported programs, the Fulbright program, and United Nations activities.

Finally, education reaches into nearly every corner of society. Whole industries are set up to serve the needs of the educational establishment, textbook publishing houses, the construction industry, school supplies and maintenance, etc. Educational policy is an engrossing political topic which occasionally erupts into local, state, and national debates. Educational settings are intimately associated with basic and applied research, with recreation, with status and positional verification, with the establishment and maintenance of community cohesiveness. Educational institutions are major employers. Some problems in education have assumed such regional and national importance (such as desegregation) to have forced major changes in our sense of morality and have led on occasion to demonstrations, riots, and violence.

Educational Positions and the Classroom

Certain social positions are well-nigh ubiquitous in American education, and most educational activities are organized around standardized settings such as the classroom. Taking as our model the public elementary or secondary school, there are three major types of persons found in education: students, teachers, and administrators. Students are normally juveniles who have little power in the school. Although they constitute the majority in any school, they are usually categorized and treated in groups. At its worst, this process is known as "lock step" education, a phrase that connotes the treating of all students within an age-grade with identical procedures.

The classroom group usually consists of a set of students and one teacher. Although experiments are now being conducted in team-teaching and other instructional forms that would provide more variability in student-teacher relationships, the usual pattern is for each teacher to operate with a group of students in isolation from other teachers. In primary schools it is normal for a single group of students to stay with a teacher throughout the day--expect for the brief appearance of a few subject-matter specialists such as the music teacher. In secondary schools and colleges student groups move from classroom to classroom, often breaking up and reassembling from different personnel. Teachers at these latter levels are assumed to be subject-matter specialists. Throughout the systems students are graded into wholistic age or achievement categories, and entrance into the next higher grade (or school) depends on the student fulfilling specific achievement criteria.

American public school administrators break into two groups--principals and their assistants, and superintendents and their assistants. The principal is the administrative head of the school, a former teacher, and nearly always a male. The superintendent is the administrative head of a school district, a former principal, and nearly always a male. Whereas for women the position of teacher is nearly always as high as they can go, male teachers can and often aspire to leave teaching for administrative positions.

Other professions are represented among school personnel, although their jobs are less central, and they command less power and attention. These include health personnel, dieticians, custodians, office staff, and engineers responsible for the maintenance of equipment.

Decentralization. American education is also decentralized. Again taking only the public primary and secondary schools, control over education is everywhere immediately vested in the public school district as created by the several states. The local legislative functions of a district are performed by a school board whose full-time executive officer is the superintendent. Various degrees of control are exercised over school districts, boards, and superintendents by the several states, but in general that control is weak and remote. Even more remote is the federal Office of Education whose functions are primarily those of record-keeping and the encouragement of research.

This pattern of decentralization contrasts sharply with patterns found in certain other urban societies, such as France, Australia, or New Zealand. In these countries public education is largely directly state-controlled through a federal or state ministry. Uniform national or provincial curriculum plans are laid down, and adherence to minimal standards for education are demanded throughout the state. These standards are enforced by state-wide examinations and an inspectorate who rate teachers and teaching performance on a regular basis. The results of centralization appear to be on the positive side, the reduction of between-school variability in educational product, and on the negative side a possible stifling of initiative at the teacher or school level.

Decentralization also appears at other levels in American education. American higher education is unique in offering students a wide variety of private as well as public colleges and universities. And although colleges offer degrees announced with more or less standardized titles, requirements for these degrees vary widely. Variations in quality are partially controlled by accreditation agencies created by the colleges and universities. Standing outside the system are a variety of proprietary schools, particularly those serving declasse occupations, often operating with only minimal state supervision.

Universality. American education is both universal and comprehensive. Universality implies that education is designed to serve everyone, this value being expressed in the statement that everyone is entitled to an education, to the limit of his own ability and inclination, but at least through secondary school. This value is supported by laws that specify attendance for all children through some secondary schooling. Some amount of college education is now becoming the goal of more than fifty per cent of our youth. If the individual chooses to attend a private or parochial school, that is up to him. But public education is to be provided for all and is seen as a major avenue by which the children of the poor may better themselves.

Comprehensiveness. Education for all implies, in America, a second value--comprehensiveness. We attempt to provide an appropriate education for everyone and to allow much flexibility for an individual to change the direction of his education should he wish to do so. All pupils are encouraged to stay in the educational marathon as long as they have the stamina; and if they do not like the race-track they have chosen to run in, they are encouraged to shift to another lane. This aim is accomplished by providing comprehensive schools at all levels of the system. Primary, secondary, and higher institutions presume to accommodate all kinds of pupils, from the sons and daughters of illiterate immigrants to those of blue-bloods. The comprehensive high school must provide not only a college-preparatory curriculum but also terminal, trade school and secretarial preparation. The comphrehensive college offers training in engineering, public school teaching, and social work in addition to the liberal arts subjects.

Comprehensiveness has its effects. Since schools must serve pupils with varying needs, specialization is weak. Schools are also forced toward increasing size in order to provide for the many tasks they attempt. Pupils may engage in various "false starts" before finding their true professions, thus wasting the efforts of those who were previously involved in his education. A far larger proportion of American pupils enter college than in any other urban society, yet we also have a large drop-out rate.

A contrasting system, seen in contemporary Britain, "streams" pupils by means of achievement tests into various educational channels out of which it is difficult to move. College preparatory secondary schools are distinct institutions from trade schools. Engineering and preparation for college teaching are not taught at the university, and a far lower proportion of English youth attend college. It should also be pointed out, however, that those pupils who do enter college are somewhat better prepared, specialize more rapidly in their education, and are less likely to drop out of college than their American counterparts.

Diffuse Goals. Partly because of its attempt to be comprehensive and partly as a result of decentralization, education serves a variety of purposes in our society, some of which are at cross purposes with others. Thus American education presumes both to socialize and to train for creativity. Pupils should not only be trained in the traditional, academic subjects but also in a variety of "practical" skills as well such as typing, auto mechanics, driving, and homemaking. The entrance age for elementary schools has been reduced so that now kindergarten is nearly universal, and public nursery schools are the coming thing. High schools and colleges provide athletic spectaculars from which revenues provide major amounts of financial support for certain institutions.

People Rather than Product-Centered. Education produces people rather than tangible products. In this it is similar to other people-processing institutions such as the military and hospitals. The advantages of a product-centered institution is that success of the mission may be easily established. Are we making a reasonable profit this year? The success of people-processing is more difficult to judge. First of all, the measurement of change in human beings is difficult. Educational output is usually measured in terms of achievement tests; but many critics have claimed, with justification, that the major values of a good education are not being tapped with this measure. In addition, the production of any people-effect is inevitably contaminated with the impact of other forces operating on the child, such as home, church, gang, and neighborhood.

Labor Intensive. Mid-twentieth century American education is also labor intensive; that is, the vast proportion of our expenditures are for salaries rather than for machines or raw materials (see Trow, McCusker, and Sorenson). The majority of activities in the school are still carried on by its staff; to date media have been used adjunctively rather than in replacement of the traditional contact between teacher and student. Capital expenditures and equipment investment in education is still far less, proportionately, than in medicine or the military. Indeed, we often make a fetish of labor intensiveness claiming that to mechanize education would destroy a necessary personal relationship between teacher and pupil.

Little Specialization. Although not a necessary concommitant of intensive labor use, American education also shows little job specialization. Particularly at the primary level, teachers are interchangeable and may be shifted from grade to grade. Secondary teachers are often called upon to "fill in" in fields which are not their specialties. Even administrative positions in the schools are generalized. It is normal for male teachers to move up to administrative positions after several years of teaching experience, and administrators at smaller schools often teach on a part-time basis. (However, specialization is characteristic at the university level where field boundaries are firm.)

Low Status. Compared to other professions, the status of the teacher is not particularly high in America, nor are American teachers particularly well trained or paid. College students recruited into the teaching ranks are predominantly female and from the lower levels of college student talent. Professors of education are looked down upon by associates from other departments, particularly by their liberal arts colleagues.

However, the relatively low status of education is not too far out of line with its character as an occupation. In many ways the job of teacher is more a craft than a profession (see Trow). The teacher's job is a general one calling for many, poorly articulated skills; the teacher's performance is isolated; the teacher's success or failure is almost impossible to judge.

Although there are clear resemblances between teaching and other crafts, labor unions have been largely ineffective in organizing teachers. However, the teaching profession is not without its professional associations which have performed prodigious feats in raising the status of teachers and placing more and more control over education in the hands of professional educators. Associations such as the National Education Association tend to be dominated by school administrators and professors of education with less influence emanating from the rank-and-file teacher.

Teaching has not attracted the gifted among college students; other fields with greater status and calling for greater talents have had more than their proportionate share of the gifted. It does not seem likely that this distribution of talent will be changed, no matter how high the salaries of teachers are raised. Nor is it clear that great talent along intellectual lines is needed for teaching--at least on the primary and secondary levels.

Little Research. Finally, like other decentralized and labor intensive industries, education in America spends remarkably little for research. Although other major industries today spend up to ten or more per cent of their annual budgets on research and stress the necessity of research in order to survive, the majority of school systems carry on no research whatsoever.

Of course, public education is a non-competitive industry. If school system A develops a better procedure for processing pupils, it gains nothing over system B for doing so, although presumably it may gain more support from its constituency.

Most basic and applied research on education is carried on outside school systems by universities, foundations, state departments of education, and industries. Most innovations in education are discovered elsewhere and must be "promoted" in order to be accepted by the local school. School boards and administrators understandably are inclined to resist rather than to welcome changes in educational practices or equipment. Local conditions are salient to local control and innovations emanating from ivory towers may often seem remote from local versions of "reality."

Media Factors Governing Adoption

Characteristics of media of instruction are also instrumental in aiding or slowing up adoption by school systems.

Cost. Cost is one of the more important factors affecting adoption of new media. Obviously, the cheaper the medium the more likely it is to be adopted.

Capital expenditure costs and per pupil costs both govern adoption. Media that require a large outlay for each student, such as O. K. Moore's computerized typewriter that teaches the child to read before he can write, are unlikely to be adopted.

Cost per unit is the second financial element in adoption. Although many individual units are needed, cost per teaching machine is obviously far less than cost per educational television broadcasting station. Adoption of media requiring an enormous capital outlay will be confined to large school districts and will be engaged in only with much careful scrutiny by the school board and its supporting public. Adoption of smaller media units, even though their cost per student may be greater, is easier because adoption may be either experimental or piecemeal.

Flexibility. Media are more likely to be adopted that are useful for a variety of educational and other purposes. For instance, if a medium is only useful for the teaching of a single subject, it is less likely to be adopted than if it may be used with several subjects. It is also more likely to appear in schools if it serves both educational and non-educational objectives, if, for instance, the medium is useful for both education and public entertainment.

It should be pointed out that media having a low cost per unit are not only more likely to be adopted, they are also more likely to be flexible in their use. Media having a high unit cost must be used widely in order to justify their use; hence use is forced on teachers and students.

Teacher Comprehension and Control. Given the labor-intensive character of American education, media are more likely to be adopted that are understood, approved, and controlled by teachers. A medium that is imposed on a non-sympathetic teacher is likely to spend most of its time in the closet gathering dust while the teacher continues to teach in ways that are familiar to her. On the other hand, if a medium requires skill and understanding in its operation, it is more likely to be adopted if teachers are provided a training program in the use of the new medium.

Fads and Pressure. To a certain extent, familiarity and approval are also necessary before the school administrator will advocate, and the school board approve, adoption of a new medium. However, both types of officials are also sensitive to outside pressures. Some media are adopted because school boards and administrators are persuaded that public demand for adoption is high, despite lack of sympathy on the part of educators. Outside pressures arise from vested interest groups, from foundations, or from the manufacturers. The Ford Foundation, for instance, has been active in advocating the use of educational television. School administrators are bombarded by literature and salesmen from hundreds of manufacturers anxious to display the advantages of their latest media developments.

Support rather than Displacement. Media are also more likely to be adopted if they support or slightly modify present educational practices rather than displace or change them. For instance, any medium that makes an existent but difficult task easier for the teacher, or that facilitates communication between teacher and pupil, or that increases efficiency of educational procedures, is likely to be adopted. Media that imply a radical shift in educational roles, or that require the creation of new positions or the retraining of personnel, are less likely to be adopted.

Student Response. Although one is less likely to consider students' opinions than those of teachers and administrators, "consumer reaction" is bound to be a factor in media adoption. A medium that was signally ineffective in fulfilling its advertised promises or was unpopular with students would not be as likely of adoption than an effective or popular medium.

Predictions

The adoption of a medium depends on the factors listed above plus others. The formulae which properly mixes these into a precise prediction will probably never be written. Nevertheless, we will be bold (or foolish) enough to behave as if we were a sage computer. Looking into our crystal ball, we see the following trends in media adoption during the next decade or two.

Minimal Adoption. It seems to us unlikely that adoptions of media will make radical changes. Education during the next decade is unlikely to cease being a labor-intensive activity, although there will probably be some increase in the proportion of budgets spent for media. Thus, it is unlikely that the classroom teacher will be replaced by gadgets of any sort.

This prediction has several implications. First of all, given the pressures for media adoption, it seems likely that some media will receive token adoption (see Janowitz and Street). Token adoption has happened before. For example, 16 mm. motion picture projectors are owned by almost schools, but are relatively little used in actual classroom instruction. Those media which are "forced" on the teacher are likely to be ignored, either out of ignorance or through preference.

Another implication of this prediction is that the adoption of newer media will not lead to significant savings (as claimed) in the overall cost of education. To save money with the use of media requires radical shifts in educational roles; for instance, teaching of large groups of students using television as a replacement for many teachers. It seems to us more likely that media will be used for upgrading the general quality of education, and that educational costs will continue to rise.

Broadcast Television. Our prediction is that airborne educational television (MPATI) is doomed to be abandoned. Although its impact on midwestern education has been considerable (see page 27), the system has such drawbacks in terms of inflexibility that we assume its abandonment inevitable. Similar, although somewhat less dramatic problems, obtain for other forms of broadcast educational television. As pointed out by others (see Knowles), broadcast educational television is being used at present far more for general enlightenment than in support of formal education. Again, flexibility seems to be the key issue. Given that an introductory course in Spanish, for instance, is available only at 10 o'clock in the morning, the teacher must schedule at that time or make other arrangements for the teaching of the class.

The technological "break-through" which makes the abandonment of broadcast television possible is the new video tape recorder (see Balanoff). Given a portable television set in each classroom and a modest investment in recorders assembled at a central location in the school, teachers may be provided each hour with a choice of various taped programs from which to choose to supplement instruction. Tapes for this use would be provided by the school district to all schools at costs comparable to or less than those of 16 mm. film. The conservative may decry replacement of the good teacher by the non-responsive television set; but as we have already noted, there are far too few "good" teachers. If our prediction is borne out, we should see a whole new industry springing up that engages in the production and distribution of educational videotapes on a variety of subjects.

Motion Pictures. But why go to videotape; why should not the same innovative uses be made of 16 mm. motion picture film or (as Balanoff suggests) better yet, equivalent use be made of the cheaper 8 mm. system? It seems to us likely that there will actually be considerable pressure brought upon the schools for just these latter purposes, and that other industries will be set up for the purpose of producing instructional films for extensive classroom use. However, film systems have some disadvantages which argue against their adoption in comparison with videotape. (1) Tape is ready for instant replay. Tape recordings may be used by the coach to help the student watch his own performance, whether the field be athletics, debating, or training in medical practice. At present, there is no marketed system for the instant development of motion picture film. (2) Tape may be played from a central location and distributed to individual video sets, thus relieving the teacher of the necessity of setting up and operating her own equipment. These disadvantages are not killing and might be obviated with new technological developments. At present, however, we would have to bet on videotape.

Teaching Machines. The biggest difficulty with presently available teaching machines is their lack of sophistication. (As pointed out by Stolurow) the ideal teaching machine is operated by a computer that not only controls frame presentation but is also capable of diagnosing needs and lacks in the student. In short, an ideal teaching machine is the mechanical equivalent of a good teacher. Although approaches to this ideal are constantly being explored, it seems to us unlikely that a really sophisticated teaching device will be available during the next decade.

Once available, a major problem with a truly adequate teaching machine will be its cost. Present annual expenditures per pupil in most public schools hover in the vicinity of $500. A computer-operated instructor is likely to require an initial investment of many thousands of dollars; in short, to be as expensive as a broadcast television station. One way to reduce cost is to connect a variety of unit "teachers" to a central computer that operates all simultaneously (see Stolurow). Such a system might provide individual instruction for each pupil one or more hours per day with each "teacher" unit used by several students during the class day. However, (once again, as pointed out by Stolurow), we lack a lot of basic information about student behavior that is needed before such a system is workable. Once such information is available it seems likely to us that adoption of teaching machines will proceed slowly with private and well-financed public schools leading the pace.

Books. Various observers have pointed out that the mass distribution of paperback books constitutes a media revolution (see McKeachie, and Janowitz and Street). We would assume to see continued expansion of this industry in education together with such auxiliary media as reprints, flexible teaching texts printed in separable sections and the like. Although minimally programmed (which may be a distinct advantage), books are portable and may be studied at the student's leisure. They are also available in the outside world (which is not true of teaching machines), hence the book reading habit may be crucial to continuing education on the part of the student.

Some pessimists have suggested that as we develop television and other forms of media which do not require literacy that book-reading will disappear. This seems to us very unlikely during the next two or three decades. Books have such obvious advantages as a communication medium that their use is bound to be stressed until a truly flexible and portable means for entertaining citizens is developed (perhaps a small television set with either a great many more broadcast channels than are now available or a widely-available library of videotapes that are also miniaturized). Thereafter we might entertain the notion that pressures toward literacy and the use of books would fall off. Perhaps in the distant future, literacy may be a skill learned only by the professional--in the sense that mathematical symbols are learned today only by those who need to know them (see Foote).

Differential Adoption. It is patently obvious but nevertheless worthwhile noting that various sectors of education will be more willing to adopt certain media than other sectors. We would suggest that homogenizing media (such as [redacted] television) are most likely to be adopted in those school districts having difficulties recruiting and holding their teachers. Small school districts and schools serving slum neighborhoods are good examples of this type of setting. In time, one might expect some schools to advertise or be proud of their continued reliance upon "live" teachers. In contrast, because of the initially prohibitive cost, we would expect teaching machines to be adopted first in those schools having the most money.

Media Impact on Education

Assuming that some of the new media will be adopted, what will be their impact on the schools? We turn now to the probable and not-so-probable results of media adoption in the educational institution in the near future. In order to explore this problem meaningfully, however, it is necessary that we first consider the goals and strategies of education, the roles of educators, and the uses to which media may be put. It will be recalled that our original definition stressed that communication devices were not educational media until used for educative purposes. This suggests that there are various patterns of uses of educational media and that media characteristics change with use. Let us explore this insight.

Media and the Teacher

One of the first things to be observed is that the teacher may play a variety of roles with respect to a medium. Turning first to instructional roles, it is possible for a teacher to use a medium adjunctively, to supplement or aid her in presentation of material. Thus, a teacher may write salient points upon the chalk board, may use visual aids, or rhythm sticks, or Cuisinaire rods, or a piano. Control of the subject matter rests in the hands of the teacher who programs use of the medium in question to supplement her distinctive style of presentation. A medium may be used to provide a close-up view of complex operations, a visual simplification of the problem, details beyond the lecture, or the "immediacy" of direct experience. (A variant of this type of relationship is found where rigid specifications of teacher media use are laid down through school regulations. Thus, some teachers are subjected to rules as to "proper" use of visual aids and the like.)

A much more radical use is to replace the teacher by an educational medium. For example, instead of the teacher offering a science lesson, the lesson is presented by television with all students sitting in a darkened room watching a centrally-broadcasted program. Under such use the teacher may or may not be present. If she is in the room, her function is reduced almost to that of custodian; or she may spend the time in private pursuits. This radical use of media to replace the teacher is only possible with such media as television or motion pictures which can fully engage the attention of students. In principle, of course, it is quite possible to replace the teacher with even simple media. Consider the instructor who writes test questions on the chalk board and then leaves the room. Provided that students are sufficiently motivated, they will carry on despite the absence of the teacher. It should be emphasized, however, that at their best even the most complex forms of media available today are but limited in the varieties of stimuli they emit and, particularly, in their responsiveness to behavior by the student. In addition, teachers perform a variety of non-instructive functions for the student, including those of counseling and acting as a role-model. For these reasons, presently available media have but limited appeal as total replacements for the teacher.

Media-related roles for the teacher may also be defined in terms of additional, non-instructional capacities. "Master teachers" are often called upon to conduct classes on television or to help write, prepare, and act in educational television productions. At a somewhat less exalted level, teachers actually set up, operate, and repair educational media. Teachers, along with educational administrators, parents, and school board members, are often involved in heated controversies over the usefulness and advisability of new media adoptions. Finally, particularly in those cases where television or teaching machines have freed teachers from some of the drudgery of instructions, teachers may assume counseling or advising roles which are made possible through release of their time.

Educational Content

Another way of looking at functions of the medium is to discuss the various contents that are communicated to the student and which the student is presumed to learn in an educational context. Three such contents have been suggested in this book (by Janowitz and Street), the *providing of skills and information*, *socializing*, and *mobilizing*. The first of these is "classic" educational content, the "Three R's," spelling, the facts of history or geography or chemistry, and the like. The second pertains to the task of civilizing students, the changing of a young "savage" into a responsible adult who can take his place in society. The third is the creation of motives appropriate to the positions which will be occupied by the student as he passes through later stages of his school career and into adult life. Other commentators have broken the providing of information down into sub-categories such as *subject matter* and *additional information* about the world, while still others have identified *group maintenance* as an educational objective, somewhat similar to the Janowitz and Street concept of mobilization.

So far the new media are conceived of as most appropriate to be used to teach subject matter. The only types of programs yet prepared for teaching machines are subject matter programs, and this is certainly the dominant use in educational television. Socializing is usually treated on a direct, person-to-person basis between the student and teacher, or sometimes between the student and school administrator, or student and counselor. The more diffuse goals of group maintenance and mobilization are not organized for directly; indeed, it is often assumed that time spent pursuing these goals interferes with the presentation of subject matter. These last, then, are squeezed into the "cracks" of interpersonal relationship between student and teacher. One wonders whether they would be dealt with at all in a strictly mechanized school.

Educational Strategies

A third way in which media functions may be viewed is in terms of the strategies or educational forms which may be recognized as part of the instructional process. Each potential strategy may also be aided (or hindered) by the use of educational media.

Doing. At a minimal level, much educational activity involves doing by students. Examples of such strategies include drill and practice, group experiences, and ritual. The practicing of handwriting is a doing; so is group singing, performance of plays and pageants, playing football, and pledging allegiance to the flag. In each case the student is learning through participation; the teacher's role is minimal; he is but the leader or a coach.

Two uses for media predominate in situations involving doing: social and self-feedback. Social feedback occurs when the student records information on the medium which is then evaluated or scored by someone else, usually by the teacher. For example, the pupil who practices writing by using a pencil and notebook is communicating to the teacher about his ability to write and spell properly. Similar uses of media are found when the student uses a tape recorder or language laboratory. Self-feedback occurs when the student uses a medium to examine his own performance with only minimal help from the teacher. For instance, the trainee may look at a kinescope recording of his performance or may learn directly from teaching machine responses.

Media may also be used in doing situations to support the coaching and leading roles of the teacher. Teachers who lead a singing lesson have greater success if they can play a musical instrument to accompany the discord. Similar functions are fulfilled by rhythm sticks or timing devices.

Dissemination. A second form of educational strategy involves the dissemination of information. In this strategy teachers perform the role of lecturer, one who "gives the word" to students. In such circumstances, the role of the teacher is an active one while the students "soak it all in."

In this "classic" form of education, the possible uses of media have already been discussed in an earlier section. Media may be used either to supplement presentations by the teacher or to replace the teacher entirely. Since the teacher is merely lecturing, she may be replaced not only with a potentially responsive teaching machine, but in this case also by a non-responsive medium such as a television set.

Exchange. The strategy of exchange involves two-way interactions between the teacher and individual students. Typically the teacher asks questions of one student after another and receives answers designed not only to reveal the knowledge of that student but also to impart knowledge to others in the classroom. Exchange is also presumed to provide motivation for students in that it keeps them "on their toes."

Only a responsive medium like a teaching machine can actually replace the teacher in the exchange strategy. Since interaction between the student and machine is usually private while recitations are social, the use of teaching machines is not the same as teacher-student exchange. There are undoubtedly ways in which it is possible to build in social support in the process of exchange using new media. One can imagine, for instance, devices such as those used in television quiz shows in which partial information is provided to students or through which feedback is provided to the teacher from more than a single student at one time. However, such media modifications have not yet been proposed for the school.

Discussion. In discussion the students are assigned the role of communicating with one another while the teacher supervises or directs. Discussion provides role-playing opportunities to students in addition to providing them access to information from sources not normally tapped in the more traditional strategies. Thus, socializing, mobilizing, and group maintenance are stressed--often at the cost of accuracy of information exchanged.

Media may also aid (or hinder) in the processes of discussion among students as, for instance, when students pass notes to one another. Interestingly enough, use of media to support discussion has rarely been explored, possibly because our prejudices suggest that pupils should be passive and should not communicate with one another. One might imagine, for instance, an "I don't know what you are talking about" or an "Aha, I get it now" meter that would provide instant feedback to others. Such devices would revolutionize discussions of all sorts, including those found in educational settings.

Intellectualization. Finally, a fifth strategy, intellectualization, focuses upon the processes of thought, upon logic, upon the forms of problem-solving itself. In contrast to the dissemination, intellectualization strategies try to create appropriate thinking processes about subject matters. Typically, intellectualizing may be recognized by the appearance of such provoking questions as "Why?," "How?," and "Explain that please." Dissemination and exchange are interested in facts, not in dynamics. Intellectualization aims at the creation of subject matter, interest and effective study habits (see Knowles). The role of teachers in the role of intellectualization is difficult to identify. Various tactics are used to intrigue, cajole, or push the student into thinking clearly about the subject matter. Exchange and discussion are encouraged, but only so long as they appear to be promoting understanding. The teacher remains "in control" at all times, although his communications may be minimal when the student is actively struggling with intellectualization.

It goes without saying that media may be used in this strategy to supplement teacher presentations and that they would not be used to replace the teacher (with the possible exception of an exceptional teaching machine). The ideal media use, however, in intellectualization is to provide student experiences through stimulation. Thus students best learn about auto mechanics not by reading a book but by actually taking apart an automobile engine that is mounted properly for educational purposes. Model skulls, dinosaur skeletons, and planetaria are now available to facilitate student experiences. In using such media for this purpose, a teacher is needed to stand softly by and to punctuate student learning with appropriate observations about the principles related to those specific experiences he is having.

New Media Uses

Apart from educational roles, content, and strategy, some media are capable of generating new educational strategies. Some of these have been referred to previously. It is useful to review likely new functions in this context, however.

Decision-Making. Various new educational media, particularly those controlled by computers, have the potentiality to aid educators in their decision-making. In addition to their potential use in controlling teaching machines, computers may also be used to control the physical environment, to make recommendations for budgetary expenditures, to make classroom assignments and for keeping and assessing educational records. Computers have also been proposed to make educational and mental health diagnoses and may eventually be used to fit educational experiences (for instance, choices of teachers) to the needs of the student.

Monitoring. Media offer a variety of opportunities for keeping tabs or snooping. One such use has already appeared in some secondary schools; the use of the public address system for the unannounced surveillance of teaching by the school administrator (shades of Orwell's 1984!). Teaching machines may also have monitoring devices built into them. Educational television also has this potentiality, as do hidden microphones and tape recorders, of providing the supervisor or rater with information about the progress of student or teacher. (Like any innovation, monitoring may be used for moral or immoral purposes. Contemporary American teachers are considerably afraid of the latter; indeed, the fear of media use for snooping is so great that one of the authors has had difficulty obtaining permission to make videotape records of classroom interaction for research purposes. The initial reaction of many teachers was that the proposed study was a veiled form of rating scheme.)

Data Storage and Retrieval. Education requires various forms of information storage and retrieval. Some of the new media have the potentiality of greatly simplifying these processes. School libraries are presently making use of microfilm and microcard devices which store formerly-printed materials in a fraction of their original bulk space. The library of the future may also feature automatic retrieval of data with computerized search and recovery processes.

Media Reproduction. Inexpensive and efficient duplication equipment has revolutionized record-keeping in the modern school. Operated in conjunction with the typewriter, such media make possible the widespread use of standardized tests, the distribution of information, and the maintenance of detailed records on students, other personnel, and the economics of school operation. Without such devices, many such services would either be impossible or would require a much larger office staff. Newly available media in this genure include photographic devices which quickly and cheaply reproduce many copies of printed material, thus allowing the teacher to distribute materials to all students of his class.

Simulation. A completely new type of educational strategy afforded by some of the new media is their use in connection with games and the simulation of complex relationships. Computers, particularly, may be used to provide experiences for the would-be businessman or military leader who would check his plan of operations against a simulated economic situation or battleground.. In the educational context, such uses of the computer may provide either instruction or fun for students. (In other contexts, similar uses predict the economic consequences of tax cuts, predict the outcome of popular elections, and help us to estimate the future behavior of other nations.) At present, most such games are difficult to play because of the need to communicate with the computer in special languages. In the future, playing such games may be simplified as computers learn to decipher and reproduce verbal orders, and as outcomes are shown in visual displays.

Media Interchangeability

Much of our discussion in the previous sections may be summarized with a single observation: educational media should not be judged in terms of their physical properties alone but rather in terms of the uses to which they may be put. When used to supplement the teacher's lecture, for instance, many media are interchangeable for all practical purposes. But the same two or three media that are useful in the lecture may not be equally useful for another purpose, such as that of replacing the teacher in an intellectualizing session. At present there is no all-purpose medium, and if there were one, it probably would be too expensive for most schools to afford. Depending on the uses intended, one or another educational medium may be preferred. Some media may be used for several purposes, some for but a single purpose which they perform admirably.

Predictions

Once again we shall go out on a limb and offer some guesses; this time about media impact on the institution of education. As before, these predictions are based on the factors previously reviewed, although explicit spelling out of our reasoning is left to the imagination of the reader.

Cost. Since we have previously predicted less-than-optimal use of new educational media (from an economic point of view), and since we have also predicted a gradual adoption of newer educational media, it follows that the cost of education will rise. In this prediction we are actually quite safe; along with most other things, the cost of education has shown a significant rise during the distant and recent past.

American education is undergoing several changes that are likely to increase its cost sharply. First there is a continuing shortage of teachers combined with a trend toward better salaries. Secondly, the physical plants, particularly of secondary schools and colleges, must be expanded if only to accommodate the larger and larger proportions of youths who are attending each year. A third factor is the increased demand for technological and professional training to man the expanded technical sectors of our economy. Finally, adoption of the new media, most of which are quite expensive, will force costs to rise.

It seems likely some increase in the proportion of our national income spent on education is in the cards and that the most likely source for these funds will be the federal government. Local and state sources are seemingly inadequate to handle the sharp increases in support necessary and school districts vary widely in their ability to support secondary or higher education. Federal support is likely to come in many guises--many of which would have to be characterized as "back door" routes. Federal funds are already available for urban redevelopment, school building construction, educational research, the retraining of technologically unemployed, Peace Corps-type activities, and the war against poverty.

Programs such as these that support education indirectly will be continued and increased. It also seems likely, however, that direct support for the major needs of education, particularly salary increases and new educational media, also will have to be provided from federal funds.

Standardization. For various reasons, the adoption of new educational media should lead toward greater standardization of educational practices on regional and national levels. Broadcast television when applied to education leads inevitably to some standardization of classroom content, as does the widespread distribution of films and videotapes, as well as the use of nationally-advertised textbooks. Educational media also foster the use of standardized tests and rating systems for educational achievement (such as minimal standards to be met prior to college entrance), an option not likely to be ignored.

Individualization. Some of the new media also have the potentiality of introducing flexibility and should generally lead to designing a more adaptable curriculum that more nearly meets the needs of the individual student. Teaching machines, particularly, should allow for individualizing experiences. But even the tape recorder or motion picture projector holds the promise of providing courses on some obscure subject for those students who want to take it, a course that a school would be otherwise unable to mount because it has no teachers in that field.

Thus we are presented a paradox: on the one hand, new media should allow for a more flexible curriculum with more options available to the student and variations in methods and rate of teaching; on the other, methods of presentation and standards of achievement are likely to become widely adopted and perhaps overly rigid.

The Abandonment of Grades. Given these two paradoxical effects, it seems likely that education eventually will move toward the abandonment of arbitrary pupil grading. Imagine the student's being free to study what he wishes from a wide variety of subject matters (some of which are requirements for entrance to certain types of higher education). His achievement in each subject chosen for study is certified by an appropriate evaluating medium. Instruction is carried on in each subject independently, and the student is instructed at his own level, perhaps together with other students who are, for that particular subject, his peers. Contact between student and teacher is either on a specialist basis or in terms of counseling, discussion, and role modeling. Best of all, the student's "report card" is instantly transferrable to other schools at distant locations who will know just the right level to begin his education in each subject the following year. This millenium is still many years away, but it seems to us that educational media may help us toward these goals.

Although the system envisaged above is within the conceivable capabilities of the new media, it is by no means entirely clear whether they will be used in this fashion. There are good and strong objections that can be raised to the erection of a network of computers from whose strands it is difficult for the individual to escape. There will undoubtedly always be some elements of the total educational system of this country which will resist the all-out use of such machinery on moral and political grounds. It may very well be, for example, that the problems of negotiating interconnections among computerized school systems will be too much for our fragile political unity to sustain and hence that networks will be incomplete, stopping at borders of school systems or states and not covering some part of the private sectors of the lower levels of the educational system (e.g., the parochial schools of the Roman Catholic Church or the secular private schools).

In short, computers will be used. Whether they will be used to the fullest extent of their potentials (both for good and evil) rests upon political decisions that will test the political climates of the future.

Varieties of Adoption. For the present, it seems likely that differential adoption of educational media are likely to lead to all sorts of disruptive effects in the educational system. For instance, we have already suggested that adoption of educational television is more likely in poorer school districts and that teaching machines are likely to appear first in well-supported suburban schools. If this is correct, we may shortly see a radical bifurcation of the educational world into "have" and "have not" institutions and perhaps the adoption of European separation between types of schools. Something of this sort is already taking place at the college and university levels where the range of size and quality is enormous, with some of the smaller schools experiencing great difficulties in obtaining qualified faculty. It seems to us possible that such differentiation may be accentuated at least in the early stages of adoption.

Another possible effect may be to slow down present trends toward school consolidation. Although whether very large schools are beneficial to students is debatable, most small high schools have found that they cannot provide the range of educational experiences assumed to belong to modern secondary education. Thus, throughout rural America the past two decades have seen the abandonment of small high schools in favor of consolidated high schools and the transportation of children. (Parenthetically, the abandonment of many local secondary schools has spelled the death of communities which they served since the schools were, in large measure, the major strong source of community cohesion and pride.) With appropriate use of new media, the reputed advantages of large schools appear to diminish. Small schools may now provide physics, chemistry, and modern algebra lessons that are of the same quality as city schools, provided only that they are in the range of a broadcast television station. The larger school still has the band, the chorus, ballet training and the famous basketball team, but these advantages may not appear to be important enough to justify dismantling the local high school. (Airborne television, MPATI, has appeared to have just this effect--slowing down the rate of school consolidations in the areas it serves.)

School Buildings and Architecture. It seems inevitable that new media will have an impact on the architecture of school buildings. Indeed, some media (such as a system of teaching machines controlled by a centralized computer) require special buildings or at least some modification of school design (as pointed out by Lehman). We may become involved in an architectural revolution quite as much as a media revolution, and it is most likely that these two innovative forms will influence each other.

For the present, however, except once again for "lighthouse" schools, school architecture will probably continue to reflect the traditions of American education, and media will have to be adopted to existing structures. This suggests that self-contained and compact media are more likely to receive immediate adoption than media requiring extensive building modifications. In the long run, school construction will have to reflect the needs of those media desired by the users (see, for example, Balanoff).

Educational Roles. As detailed previously, the new media provide a variety of new educational roles for both the teacher and supportive personnel. It seems likely to us that this will lead to both an increased specialization within the teaching profession and the appearance of auxiliary positions in the school tables of organization.

At least the following additional roles for the teacher have been suggested in connection with media: planner, script writer, actor, consultant, machine tender, content specialist, counselor, role model. Some of these roles are likely to appear as duties ancillary to the more basic job of instruction. Others are likely to be picked up as specialties or as separate jobs in and of themselves. As more avenues for specialization appear in the teaching profession, it seems to us that the status of the teacher will rise, that the profession of teacher will appear to be less a craft, that standards for teacher excellence (in various jobs) will be set and enforced, that there will be greater competition for entry into the profession, that teachers will receive a higher salary, and that the teaching career will not be terminal but will provide many avenues for both horizontal and vertical mobility. At the same time, the status of the generalist, the traditional classroom teacher, is likely to continue at a low level.

At least some roles connected with media, however, are unlikely to be performed by teachers or by anyone else presently connected with schools. These are the machine-tending jobs that require professional competence in electronics or related fields. Most universities now have a small group of electronics engineers responsible for the operation of educational television systems or FM radio stations on the campus. It seems likely that such positions will expand in importance and will appear more and more in the secondary and primary schools.

Information Retrieval. If we had to bet on a single media-related revolution in education, it would be the forthcoming improvement in data processing and retrieval. As media for instruction or entertainment, books have a great future in the next few decades. However, given the rapid piling up of information in most fields, books are becoming less and less useful as sources of information. We assume that the next two decades will see the rapid development of techniques for encoding, storing, and searching information, and that research libraries may shortly be linked with one another by means of media that allow not only for information search but also for the reproduction of desired materials for individual use. In fact, if methods for "home" reproduction get much cheaper, it will be less expensive for the student to order a copy of a desired work from his local library than it will be for him to buy the published volume.* Should this occur, it would not only drastically modify the publishing industry but also force a completely different system of communication and status validation upon scholars. Once again, such media developments hold great potential for individualizing education to suit the needs of both teachers and students.

Centralization and Planning. It seems inevitable to us that media adoption will tend to force American education toward greater organizational elaboration creating pressures toward centralization and planning. Certain media, such as broadcast television, are too expensive to be entered into by any one school system, except the very largest. In any event, most media presently envisioned demand some organization for their full realization. For instance, videotape recorders and motion picture projectors are of greatest use when accompanied by sets of prepared tapes or films which may be used with them.

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*There are important legal issues concerning when such reproduction constitute infringements on copyrights, which the courts will undoubtedly have to face before long.

It seems to us that pressures toward centralization will be manifest at several levels. Local school districts are likely to consider more seriously consolidation with others or at least cooperation in specific purpose federations. For example, consider the urban school district that would like to operate a broadcast television station but feels that it cannot support the station alone. Should it not then appeal for cooperation and financial support to surrounding, suburban school districts that will also benefit from the programs to be broadcasted?

Another type of centralization will take the form of planning or policing bodies. It seems certain that wider spread of media schools will demand standardization of media and media-related practices, if only to protect their capital investments.

Finally, some type of centralization is implied by growing federal and state support of education. The time is not far off when Americans will no longer tolerate really bad local schools if only because students educated in those schools will have less and less of a place in our complex economy. If standardization is in the wind, centralization and planning are also implied.

Media and the Evolution of Society

Our third task is to examine the impact of new educational media on society. The difficulty of this task is complicated by the lack of separation between educational and non-educational uses of media. Thus the impact of educational media is difficult to separate from the impacts of other societal processes, particularly new developments in education itself.

Previous Impact of Media on Society

For the most part we have already covered in previous sections the impact of new educational media on contemporary education and vice versa. Before turning to the likely future impact of these developments on American society, it is worthwhile to examine briefly the impact of previous innovations in mass media of communications.

To begin with it is important to realize that those technological innovations that have affected society most significantly and most directly have not been media. Most societal forms have appeared to vary as a function of techniques of production. Thus, anthropologists usually discriminate between "hunting and gathering," "food storage," and "exploitative agricultural societies" in pre-commercial cultures. Similarly, the rise of industrial civilization is usually tied to the use of steam generated by fossil fuels as a source of power.

Two previous media developments have, however, had a significant effect upon the forms of society, the development of writing and the invention of printing. The first of these inventions, writing, presented man with the opportunity of communicating thoughts to others at a distance and of supplementing memory with relatively imperishable records. These facilities, in turn, made possible the development of commerce and commercially-based civilization. It should be pointed out, however, that prior to mass distribution of printed materials, literacy was the property of the few. Slaves were not literate, nor need the lord learn to read and write. Priests, money lenders, and mercantile officers were literate, and often they guarded closely the "mysteries" of literacy.

The appearance of printing made communications media available to the majority for the first time and provided an impetus for universal literacy. It also had the effect in Europe of turning over many old forms of society. Literate laymen were no longer satisfied with the interpretations of holy writ provided by the clergy, hence Protestantism. Literate citizens were no longer satisfied with the divine right of kings and later with economic bondage, hence the American, French, and Socialist revolutions. Science was made possible, and the rate of social change sped up. In a real sense, we are still in the toils of adjusting to the effects of printing, since a large proportion of the world's citizens are still, unfortunately, illiterate.

It is likely that we are presently experiencing a third, major media revolution, since the appearance of electronics has made possible not only the transmission of visual and audio signals but also the reaching of a mass audience simultaneously. However, this latest media revolution has been accompanied by other radical developments in sources of power, forms of transportation, and weaponry so that we cannot isolate the effects of the new media alone. In fact, changing technology is now proceeding at such a pace that adjustment to each new development is only just begun before a half a dozen new developments are upon us presenting their new and pressing problems. This rate of technological change has no precedent in history, and in this sense we are living in ahistoric times.

Predictions

Once again we take up the crystal ball and venture predictions--this time about the impact of educational media on American society. Some of the predictions made are but extensions of earlier predictions made for the institution of education. Others run counter to predictions made earlier where we feel that different forces are abroad in society. Once again, the rationale for each prediction is but minimally sketched.

New Roles for Citizens. One obvious effect of the spread of educational media is the creation of new roles for citizens. (As is pointed out by Knowles) the potentialities for adult education through mass media are but barely tapped today, and individuals will soon be faced with an increasing variety of educational opportunities that are attractive and worthwhile for him. This fact has at least two implications. The first is that education will soon be so expertly packaged and painlessly administered that educational media can compete with entertainment on equal terms. To give but one example, a large number of people today are learning history through historical novels and other paperback books read for pleasure. Their "education" is absorbed painlessly; indeed, they do not even recognize it as education. It is possible that with appropriate media use, we may do away entirely with the experiences of "painful learning," although it is still unclear whether intense professional commitment can be created without "blood, sweat, and tears."

Another implication of mass education through media is a shift in recreational patterns and a vast upgrading of the level of education of our citizenry. As was pointed out earlier, other forms of technology tend to release time; media fill time. Media also create a more sophisticated citizen group. It seems likely that increased exposure to educational media will create not only a more highly educated citizenry than heretofore, but also one that demands more and more varied forms of mass media, hopefully on ever higher levels of sophistication.

The above changes pertain to the consumers of mass educational media. Changes must inevitably also come to those who produce and communicate through these forms. Along with other technological revolutions in progress, it seems clear that educational media will increase the professionalization of society. The invention and operation of media take a host of highly trained persons, and their jobs will remain essential to the operation of educational media--at least until the computers take over.

Media Competition with Schools. In time, the popularity of educational mass media may lead them to compete with, even to eliminate, some forms of schools.* If, as we have suggested previously, educational achievement is to be judged by subject matter achievement rather than by arbitrary grade, there is no real reason why the student cannot study at home or wherever he has access to a teaching machine, or portable television set or videotape player. If sufficient flexibility is built into a mass public educational system, it is possible that schools and colleges may become anachronistic for the purposes of simple information dissemination. We would assume, however, that the other functions of education, such as socialization or mobilization, would be harder to provide through media and would be recognized as a major contribution of the classroom experience and an alert, understanding teacher.

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*Just as vocational education within industry and the military establishment have succeeded where the public schools have failed in providing skills necessary for the lower levels of technicians in our economy.

Reduction of Provincialism. One of the major effects of mass media today is the reduction of provincialism. Regional accents are dying out; regional customs are disappearing; more and more people are becoming aware of national and international problems and are less concerned only with the problems of their town or country. Educational media cannot but help to speed up this process. Indeed, we can expect that the reduction of provincialism will take place on an international level. Today, radio stations and television are bridging national boundaries in Europe. Tomorrow we would hope to find the same phenomena occurring across the Atlantic and Pacific.

In the long run, one of the consequences of loss of provincialism will be the amalgamation of languages. We are certainly not the last generation to live in a world largely separated by language barriers, but we are probably the last to be largely uni-lingual. Particularly with the spread of media that do not require literacy, such as radio and television, we can expect the appearance of an international "pidgin" that is spoken and understood by all users of media. Changes in written languages will take more time, and that for a time persons of a given country will speak to others in "pidgin" and write to themselves in their native tongue. We have already predicted that in the distant future, there will probably be a collapse of literacy. It is possible that the professional of the future will speak "pidgin" fluently but will know only the written or symbolic language pertaining to his own profession.

Individualization. Again, we would have to predict that along with the reduction of provincialism would go an increased potentiality for individualization through the use of educational media. We are already seeing in America the specialization of certain communications channels; for instance, FM radio is used today for educational programs, good music, and jazz. It is likely that we will find increasing use of functionally-differentiated media; television stations specializing in news, sports, or enlightenment; videotapes available on the market as records and audio tapes are available today. The citizen of the future may find himself presented with an endless variety of educational experiences all available at prices he can afford to pay. This suggests that although no longer a provincial, our citizen of the future may have within his reach a larger variety of skills, knowledge and experiences and that society will have to tolerate many interests and foibles in its citizens.

As-Yet-Undeveloped Media. Finally, it is at least fun to speculate on new media developments that have not yet appeared but which may be in the offing. One candidate (suggested by Balanoff) is the all-purpose medium, the computerized teaching machine-television-motion picture set. Another development actually being tested today is the two-way visual-audio communicator. (Although we would usually think of such a device in terms of science fiction, Bell Telephone is actually trying out a visual, long-distance telephone as this is being written.)

Two related devices that will revolutionize both office procedures and social research are the dictating typewriter and the speaking reader. The former is a device that will accept standard English spoken dialogue and will prepare an accurate, written transcript. The latter will scan a manuscript and read it out loud.

If one wants to go way out on the limb, we are probably not too many years away from broadcast power and efficient space travel. But for sheer impact on human society, we cannot think of any devices that could be more explosive in their effect than the anti-agathic pill and the telepathic transmitter. The former will be some form of chemotherapy that will stay indefinitely--the processes of aging. The latter will consist of a small device, perhaps the size of a hearing aid, that will transmit the thoughts and feelings of the wearer to others who are similarly equipped. Both devices will have radical effects on our form of society. The former will change our attitudes toward personal danger, particularly war; and will force a re-evaluation of the institutions of family and child-rearing. The latter may act to reduce both personal and social inhumanity although it may reduce our access to privacy.

Beyond this point the crystal ball is too clouded. If there is one last message we would like to leave, it is this: educational media have enormous potential for both use and misuse. Together with other technological revolutions in process, media are forcing us to new ways of life. If we accept the challenge, if we plan, if we anticipate the needs of people in connection with these media, we will build a better world for all.

If we do not properly employ them, the world we build can be a grim, living or lifeless hell.

PART II

RECENT AND PROJECTED TECHNOLOGICAL DEVELOPMENTS

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CHAPTER II

NEW DIMENSIONS IN INSTRUCTIONAL MEDIA

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Introduction

Sometimes called the technological educational revolution, sometimes referred to as automation in education, radical changes are occurring in the use of media in education. Modern technology has provided educators with new means for searching out and developing advanced techniques in teaching, learning, and research. Although this technology has only recently received public attention, the media are not as "new" as it would seem. The first teaching machine was manufactured commercially for educational use as early as 1928. Only within the past four or five years have educators adopted these teaching machines and structured programs for them. Television, introduced commercially in 1948, gained approval of educators more rapidly. Audio-visual devices such as tape recorders and motion picture projectors, once used occasionally in school systems, are now found in increasing numbers throughout the country.

Much of this technological development dates from the flight of Sputnik and the renewed and concentrated interest generated in our nation in education. Both the popular press and scholarly journals reflect an awareness that our nation needs to give more attention to the entire educational system from pre-school through adult training programs. The fright engendered by Sputnik stimulated large appropriations for education in Congress. For example, we are now spending ever greater sums to make up the gap which has apparently occurred in science education the past few years. Congress has passed numerous bills under the National Defense Education Act and, in so doing, has given governmental recognition to education as a defense measure.

One part of the National Defense Education Act provides money for educational institutions on a matching basis, on a loan basis, or on other bases, making available funds to purchase electronic and mechanical aids to education which purportedly should help close the gap. Millions of dollars have been distributed nationally in the past few years to provide equipment for schools. Private foundations, too, are pouring millions into research projects designed to make use of new devices.

While much of this money has been spent wisely, too large a portion has been wasted in purchase of equipment which faculty did not know how (or did not wish to use) or which was of decidedly inferior quality.[1]

It is the purpose of this chapter to describe some of the newer devices, hopefully the better ones. Inclusion, however, does not endorse, nor does exclusion condemn. "New" media may be a misnomer, for "newness" is relative. In some institutions of higher learning a tape recorder is a common instructional aid, in others a device that may have potential. We shall discuss most of the media of possible importance to higher education in terms of the future, regardless of the length of time they have been in use.

Devices which have been in use for a number of years include the still camera, the motion picture camera, the motion picture projector, the overhead projector, the opaque projector, the filmstrip projector, the slide projector, and the tape recorder. Newer devices include television, teaching machines, computers, instantaneous reproducers, and "media systems or multi-media devices." The telephone, an old device in the sense of commercial use, has received much recent attention as a new educational device.[2]

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[1] Despite warnings that prospective users of electronic devices should be trained prior to purchase, equipment has been provided for instructors who do not know how to use it. Quantities of such equipment gather dust on school shelves and in storage spaces. Although much unused equipment is of excellent quality, manufactured by reputable companies, other equipment is of poor quality. Pressure to purchase equipment has been exerted on administrators who have responded as a way of taking advantage of available government and foundation money. As a result, the educational market is flooded by many different devices, good and bad, with and without a practical potential.

New Trends

Three major trends are evident in the production of new media. One is the trend toward miniaturization. Miniaturization has been given impetus by space flights which require compact and minute pieces of equipment packed in very small capsules. Industry, quick to turn its attention to other uses to which miniature equipment might be placed, looked to the educational market, albeit with some askance, since each educator has his own concept of how an electronic unit should be developed. Several years ago the transistor, used extensively in military applications, was not provided in educational systems because it was expensive and difficult to maintain.

As transistor theory and competence in manufacturing have developed, transistors have become more stable and less costly. This has made possible the introduction of the transistor for audio-visual equipment. Educators are now demanding transistorized units which are smaller, lighter, more compact. In addition, studies of users have shown that transistorized equipment, after the initial period, is most reliable and much more durable than the standard vacuum tube. Transistors, or other "solid state" components, have made possible the miniaturization of equipment. Lighter weight makes such equipment more portable, and portability makes possible more flexible use. For example, a transistorized tape recorder weighs eight or nine pounds, whereas a comparable tube system weighs eighteen to thirty-five pounds. Increased reliability and lighter weight make such equipment desirable to the educator.

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[2] A major difficulty encountered in discussing new media is the rapidity with which change takes place. A purchaser of electronic equipment needs to recognize that scientific advances in electronics brought about through on-going research in many industries may make a product obsolete before it reaches the consumer market. The time delay between design, production, and distribution also affects obsolescence.

If an administrator defers use of certain educational media because he knows newer and better equipment will soon be on the market two injurious effects occur. First, the manufacturer is forced out of the educational market. Second, the equipment of the future will remain on the drawing board. The manufacturer can improve a product only if someone is willing to buy model A. Successive models B and C will not appear if model A is not purchased.

Another trend is toward simplicity. Most educators are reluctant to accept electronic devices because they are uneasy in the role of technician. But once a device is simplified so that it may be used easily, it becomes much more useful. Tape recorders have fewer control knobs. Tape is less subject to breakage. Tape recorders and projectors are incorporating cartridge load. Simplicity of operation, then, accompanies miniaturization as a trend in the production of educational media.

A third trend combines various units now on the market. For example, the slide projector and tape recorder were once two separate units. Now it is not uncommon to find tape-activated projectors of various kinds. The tape-activated projector is a system in which slides in a 2x2 slide projector are advanced by cues on one track of a tape recorder. Another track on the same recorder provides a commentary to accompany the projected pictures. This makes possible a simplified presentation device for the classroom or for individual instruction. An instructor might make a series of slides (which he can do himself on any box camera), load the slides into a magazine-type or drum-type projector, and project them on cue from a tape which he has made to accompany the slide presentation.

This dual use of equipment is sometimes called interrelated use of media or combined media, and such flexible systems are being adopted gradually.

Television

During the past ten years television has probably received more attention than any of the other media in education. Two general types have developed. First, there are the educational stations operated by communities or universities. These stations operate much as commercial stations do except that they are supported by community or state funds, they are not permitted to carry advertising, and their programs are primarily informational. Such educational television has as its purpose the cultural enrichment of the viewer. Second, there are the closed-circuit installations supported primarily by educational institutions for purposes of on-campus instruction.

Broadcast television.--The educational stations are developing a network which should be in operation in the population centers of the United States within the next few years.[3] The educational stations have patterned their operations after the commercial broadcasters and will probably continue to do so in that they will require a high standard of program quality. Programs will consist of several types: enrichment programs for various minority groups, basic instructional programs for mass audiences, in-school broadcasts of courses of study in a school system, adult education courses for both credit and non-credit, and educational entertainment. Undoubtedly the quality of such programs, now ranging from mediocre to good, should rise as the network grows. It will be possible for stations to produce fewer programs locally and increase the quality of these programs by making use of other members' productions to fill out the schedule.

There are problems inherent in such a network. As control of educational programming shifts to such stations, communities must be alert and see that these programs reflect their interests and those of the nation as a whole. Networks operated by poor educators or poor citizens can obviously create real problems in this country. On the other hand, we must be careful not to legislate censorship or controls, for freedom of speech would most surely be jeopardized.

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[3] In 1959, the National Association of Educational Broadcasters, under contract with the United States Office of Education, conducted a conference on the operation, planning, and feasibility of live, interconnected, state and regional networks, for both educational television and educational radio. The proceedings, entitled "The Feasibility and Role of State and Regional Networks in Educational Broadcasting," provide an interesting and important body of information.

The publication summarizes the activities of the oldest and largest existing state radio network, the Wisconsin State Broadcasting service. One of the oldest state television networks, the Alabama ETV network, consists of transmitters owned by the state and licensed to a television commission. These nets are fully described in the report.

Through its Southern Regional Education Board, the southern states intend to establish a network connecting over three hundred colleges and universities in the South. The sixteen states cooperatively will operate the system which will provide programming on various levels for the state

State institutions such as the University of Alabama and the University of Texas already have large production centers turning out complete courses on tape. The Southern States Work Conference, sponsored by the State Departments of Education and State Education Associations of the Southern Region, produced a casebook of programming practices entitled "The Public Schools and Television" in 1958. This publication covers such topics as--

> ...the administrative uses of television in the public schools, in-service teacher education in the public schools, utilization of television for direct teaching in the public schools, utilization of television for enrichment and supplementary instruction, using television to extend the school's objectives beyond the scheduled school day, television in the public schools for adult education, television for public relations, programs which interpret the public school program, closed circuit television in the public schools, and the use of television in the public schools for teacher recruitment and pre-service education.

This publication is still valuable for its summation of the scope of programming which might be incorporated into a network for a higher education system.

In September, 1957, the Chicago City Junior College experiment in television instruction began, utilizing the facilities of educational station WTTW, and was supported by the Fund for the Advancement of Education and the Chicago Board of Education. The first year's programming included courses in English, mathematics, science, humanities and business education. The Chicago program has been enlarged each year, and is a model of what might be accomplished in a high-density population area.

One of the most costly and spectacular broadcast television projects is the Midwest Program on Airborne Television Instruction, generally known as MPATI (Empatty). MPATI is a project financed by The Ford Foundation, costing (according to announcements) something over seven million dollars to place in operation. Private industry, hoping to sell television equipment to schools, has poured several additional millions into the project. After four years of operation it is difficult to assess the value of the program. Close to seventeen thousand classrooms in a six-state area in the Middle West have received television programs from a DC-6 flying several miles over Montpelier, Indiana. Two transmitters are used in the plane so that two programs can be broadcast simultaneously.

From the beginning the project has been an ambitious one. Although MPATI figures showed that money could be saved with an air system rather than a ground one, two hundred institutions could have been provided with video tape playback units at fifty thousand dollars per installation. This might have enabled them to program courses in each school system as needed.

The MPATI classroom programs consist of televised taped lectures. Approximately twenty or thirty minutes of discussion time is left following each tele-lecture so that the classroom teacher can work individually with the students.

At the end of the first year of programming by MPATI fifteen taped courses consisting of 1,334 telecasts were made available. Each course covered a full semester or full academic year. Representative courses included "Wonderful World of Numbers," arithmetic for grade six; "Bonjour Les Enfants," conversational French for elementary grades; "The Science Corner," elementary science for grades three and four; and "Beginning Russian" for the college level. Programming has been provided from the lower elementary grades through the college level.

Probably the finest achievement of the MPATI program is the coordination of many and diverse independent school boards and school systems and school superintendents. Educators, known for their independence, have been successfully brought together, and have accepted a single course content for hundreds of schools. Again, it should be pointed out that each of the televised lectures is usually followed by local discussion and/or instruction. Quality of the program has been satisfactory from an administrative standpoint.

With new inexpensive video tape recorders on the market, it is conceivable that such vast programs as MPATI will no longer be necessary. Recorders placed in each educational institution would allow individualized program schedules rather than mass programming. Regional tape libraries could be expanded to accommodate more schools, and programs could be made available to each institution for repeated use.

Commercial programming for education.--Commercial broadcasters have also shared in the educational effort with such programs as the Walter Damrosch music appreciation series, which once found its way into hundreds of classrooms throughout the country in the early thirties, and its more recent counterpart on television, the Leonard Bernstein programs with the New York Philharmonic.

The National Broadcasting Company, in cooperation with the American Association of Colleges for Teacher Education, developed the Continental Classroom concept, in which a college television course for credit was presented each morning via the facilities of NBC network. One course in the series, "Physics for the Atomic Age," received much attention. At this writing we do not have figures on the specific cost per student of the program. In some areas hundreds of students participated in the course for credit. In others, so few students enrolled that the participating university was forced to discontinue offering credit. Although credit enrollments were not spectacularly high, the value of such a course should not be underestimated. The subject matter is of vital concern and if one student was encouraged to pursue a successful career in physics, might it not have been worth the effort? Too, much information was derived by those viewers who did not enroll in the course for credit. Because the course was taught in the early morning hours, usually between six and seven, many persons used the time to a better advantage than they might otherwise have done.

Closed-circuit television.--In addition to open-circuit broadcasting, there are many closed-circuit or limited range systems installed in colleges and universities throughout the country. Closed-circuit installations are similar to the one at Stephens College. Since 1955 the college has utilized television in its instructional program with one television studio disseminating live programs on a coaxial cable to seventy-five locations on campus. In addition, the college has been distributing films via its closed-circuit system. The Learning Center has expanded its facilities to two television studios and to two radio studios. This has increased the flexibility of programming, and video recording facilities have enabled the college to retain materials that have been programmed.

Two recent television installations of interest are at Florida Atlantic and Delta College. The former has an elaborate dissemination and retrieval system utilizing closed-circuit television systems. The latter provides an example of utilization of television for complete film and tape distribution.

One of the earliest mass experiments in the use of closed-circuit television took place in Washington County, Hagerstown, Maryland. Although this project was concerned primarily with primary and secondary education, it did indicate a method for implementing using state networks for higher education. A coaxial cable was used to link a group of schools in which television was part of the regular instructional program. Courses offered from grades one through twelve included the entire range of academic work found in these grades. The program is continuing successfully at this writing, and is used by a majority of the schools in the county.

Television equipment

Numerous television systems are available to educators. Primarily the equipment is the same as that used by broadcast stations. The studio cameras, film chains, and associated equipment are of two types, designated by camera pick-up tube. The image orthicon system is more expensive to purchase and to operate, but provides more latitude in production. The vidicon system has certain limitations, but offers the advantages of lower initial expense and lower operating cost. Vidicon systems vary greatly in quality and refinement. Depending on the needs of the institution purchasing them, a camera chain can cost from one to ten thousand dollars.

One of the more unusual television systems is that produced by Electra-Megadyne, Inc., a British company with distributors in this country. One of their television cameras is shown in Figure 3. It has a remote control mechanism and zoom lens, enabling an operator to focus on a slide projected from a remotely controlled Eastman Kodak projector, or on a motion picture projected from a Bell and Howell projector shown behind the camera at the left. The camera can also be trained on an instructor in the studio. In an adjacent control room, one technician with his control panel can direct the program. (See Figure 4.) On the control panel, shown in close-up in Figure 5, are located controls which enable the operator to pre-set his camera at any one of five positions. By simply pressing a button he can make the camera focus, tilt, pan, or zoom to the pre-set position at any pre-set speed. Advantages of such a system are obvious. Simple educational programs can be produced with a minimum crew and maximum efficiency. Until the price of such equipment is reduced, however, it is unlikely that school systems which could make the most use of this kind of system will be able to purchase it.

<ins>2500 megacycle</ins>.--Another recent development given Federal Communications Commission approval in July, 1963, is the on-air closed-circuit television system. Rather than rely on a cable this system utilizes a reserved frequency band to transmit several programs simultaneously with low-cost transmitters and highly directional antenna systems. The first use of the new system was made during the 1962-63 school year at Plainedge, New York. The Plainedge school district provided in-class lessons to all schools in the district.

This new distribution method will undoubtedly have applications for higher education if large geographic areas need to be linked together, but will not necessarily replace cable systems for small campuses.

Video tape.--The video tape recorder or television tape recorder, is a device for recording visual pictures on tape much as audio messages are now recorded on an audio tape recorder. The television recorder is a more complex machine, of course, and until 1963 was not available in an inexpensive model. In that year three companies announced recorders selling for approximately twelve thousand dollars. One company introduced a sixty-five dollar attachment for home reception. These units do not qualify as broadcast units because of certain electronic differences, and do not compare in complexity or in quality with the machines used by broadcasting stations which cost forty-five thousand dollars or more, depending upon optional items of equipment which must be added to the basic purchase in order to operate successfully. A total system may cost seventy-five thousand dollars. The low-cost Ampex unit can now be modified and made available for broadcast use for an additional twenty-six hundred dollars, or a broadcast model may be purchased for about fifteen thousand dollars.

Manufacturers will undoubtedly miniaturize and reduce the cost of the less expensive machines so that more and more institutions will be able to make use of them. The advantages of tape recording are numerous. Entire courses can be placed on tape and a teacher can be freed to work individually with students. Lectures can be given once rather than two to five times each semester. The machines can be used to analyze pupils in any of the performing arts--music, theatre, and dance. The image and sound can be recorded and played back almost instantaneously. A student of the violin might play a passage and see and hear that passage replayed for him immediately. In physical education immediate recording and playback makes possible correction and analysis. In public speaking, debate, and, in fact in all communication, a recorded image can be made and played back for analysis and improvement. In the field of education a tape can be made of a class in session. That tape can be re-played numerous times to discover details concerning learning and instruction that might be lost with normal observational techniques. Schools of education and departments of psychology will no doubt purchase a number of the machines in the future.

Television and the practitioner.--As so often happens when new media are introduced, the appearance of television developed several camps representing varying philosophies of use. Probably the oldest educational group dealing with television is the National Association of Educational Broadcasters, an organization founded almost forty years ago for the purpose of utilizing the then new medium of radio for instruction. This pioneering group represented colleges and universities primarily. The dedication with which members of the organization approached radio broadcasting, as well as the support they were able to muster from administrators and legislators, resulted in some remarkable successes. Of the broadcasting stations still in operation, WHA at the University of Wisconsin, is generally recognized as the pioneer educational radio station. That station continues to broadcast the well-known Wisconsin School of the Air. The State University of Iowa and its AM-FM operation, WSUI, is another representative example. In most instances the long-lived educational stations have been patterned after commercial broadcasting stations with two notable exceptions, absence of commercials and more programming of an educational nature. Educational broadcasters, while occasionally breaking the thirteen-week, fifteen-minute, thirty-minute, sixty-minute, segmented lockstep imposed by the broadcasting industry, have, however, often hampered their usefulness by clinging to such standards.

Most of the broadcasting stations in higher education serve a dual purpose, that of providing the community with educational broadcasts, and that of serving as a training ground for students interested in employment in the industry. Many announcers, writers, and administrators have launched careers on campus stations.

With the advent of television the National Association of Educational Broadcasters extended the scope of its operations. With an extant organization the group was able to plan television development more carefully than had been the case with radio. The organization, with its own predilection for a professional standard of operation, gathered together under the NAEB banner campus and community educational television stations.[4]

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[4] This material consists of several well-defined types. There are enrichment programs, designed to reach a majority of viewers for purposes of increasing the cultural level of the mass audience, elite programs for minority

While the NAEB and other educators and civic-minded individuals were setting up educational television stations, a second significant educational group, the Department of Audio-Visual Instruction of the National Educational Association, decided that television was primarily a dissemination medium rather than a classroom teaching tool. This group, composed of audio-visual specialists in colleges and universities, has been instrumental in introducing the motion picture projector, the slide projector, the filmstrip projector and the tape recorder, among other aids, into classrooms. DAVI members are dedicated educators who firmly believe that communication should be visual as well as oral. However, the majority have been trained in use of visual communication confined within classroom walls. They have worked out excellent formulae for screen size relative to room size, size of lettering relative to distance from the viewer, and "teaching effectiveness" relative to type of equipment. Probably as a result of the emphasis on the confines of the classroom rather than mass media, the DAVI group decided not to include television in its list of audio-visual devices. Within a few years, however, the group recognized that television had many applications in education and might be an important audio-visual system.

The result is an audio-visual approach that differs from the broadcaster approach in one major way. The broadcaster considers television as a mass medium, one which requires professional standards of production. The audio-visual specialist regards television as primarily a dissemination medium, and considers its use in conjunction with motion picture projectors, slide projectors, and tape recorders. To audio-visual specialists television functions as an unseen observer that can move into a classroom and present information to people watching outside of the classroom. No production pre-planning or crew is necessary in this concept, only a remotely controlled camera system operated by a technician who aims the cameras so

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audiences, sometimes numbering under a hundred, and complete courses of instruction brought from the classroom into the studio. These courses can be offered to a larger audience at less expense than in a classroom containing a few students.

that various aspects of the classroom can be observed. Several cameras may be placed in the classroom to observe the instructor and students at work. This system is primarily used for teacher education or evaluation of instructional methods. The audio-visual specialist also uses the television camera to enlarge a display, provide a demonstration, or show microscopic materials on a television screen so that all students within the classroom may have a "front-row" seat. Note that these uses are all effected within a classroom concept. Television is used as a classroom device.[5]

Probably the major operational difference developed by the two organizations is that the broadcaster believes in a professional broadcast approach based upon commercial standards, while the audio-visual specialist is concerned with use of television as another classroom device. Out of this approach grow two separate philosophies of presentation.

The broadcaster insists that the program must move along quickly and visually, with full pre-production and with rehearsal whenever possible, while the audio-visual specialist views the teacher as a "teacher-in-a-classroom" whose personality and materials can be disseminated to a large group simultaneously. This approach generally does not demand as much pre-preparation time, nor as much rehearsal from the instructor, nor is a professional crew required to produce the program. In all likelihood television will be used more and more to fit particular situations, with both groups recognizing there is room for both approaches. For example, which is the correct approach? An excellent instructor of history, noted for his scholarship and his writing, is asked to appear on a television program presenting a course in American history. He accepts, but resists all attempts to change his approach to conform with professional broadcasting standards. He refers to cameras on the air, asks that they move into position if they are not ready at a given time, and points out how certain television limitations inhibit his presentation. To the professional broadcaster this is heresy. The broadcaster believes everything should move smoothly toward a given end, with a director in control of the situation, and with the studio crew performing its functions at the proper time. A mistake on the part of the instructor which causes a wrong cue for the cameraman is distasteful to the professional; he knows that any distraction interrupts the message, and that the message must be presented clearly, concisely, and with a minimum amount of static.

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[5] As qualified teachers become less numerous and student population increases, colleges and universities will try to distribute a professor's talents to more than a classroom full of students. That this approach is economical has been proven by such studies as those at Penn State University which indicated that if class size is about two hundred students or more it is more economical to broadcast the course rather than try to repeat the lectures to students in a number of sections. The teacher's lecture time is reduced and he is free to prepare his materials.

The audio-visual specialist would concur with this, but does not consider the hesitancies or errors normal to a classroom as out of place in broadcasting. To reduce costs and staff the audio-visual specialist is likely to accept the situation in which the instructor remotely controls his own cameras. Happily enough both approaches seem to work. The Air Force Academy has an excellent teacher-operated studio. The professional will point out, however, that the Air Force Academy also has a controlled audience, one that is not likely to turn to another station while a lecture is being given.

One needs to recognize that given situations call for different approaches. The Academy approach might not be acceptable to a group taking a course of home study on a local broadcasting station. On the other hand it might be quite acceptable for the learner who moves into a situation with a given precept; he can be considered interested in and a participant in the program. This means that he will not be as critical as he might if he were being entertained.

The problem of professionalism is probably not serious, although it may be debated for a number of years. In all likelihood, exigency will continue to be the dominating factor. If an institution of higher learning can attract excellent classroom instructors who inspire students to their best efforts, then these instructors will probably succeed on television. Inspiring teachers are a key to good education. Although qualified research is extremely important, of equal importance is the teacher who can ignite the spark in a student--who causes that student to forever question whatever he reads, hears, and sees--who helps the student develop the "inward search."

The new media are but tools in the process. If these tools can speed the process, if these tools can fire a spark, if these tools can provide us with a better system of education, then, and only then, will they have served their purpose. To automate, to miniaturize, to visualize, have meaning only if they can improve upon the ultimate goals. A number of us in the field of broadcasting and of educational media in general believe that communication does take place and that learning does take place when media are properly used.

Program interchange

It is likely that regional associations will be formed for the interchange of instructional materials produced in various institutions. This can effect economies and offset the costs of equipping each institution. For example, a university with a strong music program might offer a course in music theory, record the course on tape, and provide it for members of the educational community who do not have equal resources. The institution with a strong curriculum in music may lack a science program. Another with an outstanding science program could record its courses and provide a science course for the first college.

One of the problems arising out of interchange of courses is that of how to develop courses usable at more than one institution. A number of institutions have produced for local use complete courses in psychology, science, mathematics, and language. Much duplication of effort has resulted. The United States Office of Education, as a Title VII project, has provided for four regional instructional television libraries to serve the entire country. These libraries publish a catalogue of holdings in many campus and community production centers. The latest guide published by the Instructional Television Library Project describes 282 complete courses. Of these, eighty-two are for the college level.

In addition to listing courses on tape or film, the library endorses certain tele-courses which it has evaluated. Before the library endorses a program, samples are viewed and studied by committees of subject-matter specialists and supervisors, and are approved for content and quality of production. Dr. Paul H. Schupbach, Director of the Great Plains Regional Instructional Television Library in Lincoln, Nebraska, points out in a letter that endorsement "assures availability of all materials at costs well below those of original or local production." This means that if colleges are willing to accept programs produced by other institutions, fewer colleges will need to have production centers, and those centers that do exist will be able to produce programs of better quality by concentrating on one or two areas rather than all areas.

Many university production centers are now turning out more live programs daily than are the major networks. Often forced to produce these programs with teachers unfamiliar with the medium, with sub-professional crews, and with low budgets, the centers have recorded courses of poor quality. Colleges and universities need to coordinate production so that multiplicity ceases to exist, and so that the best production and best instruction go into each course.

Standardization of courses raises a problem of control over course content. Each institution prides itself on the quality of its instruction. As a result, institutions are reluctant to adopt a course unless it has received careful evaluation. This may result in courses designed to meet everyone's needs which meet no one's needs. The approach used by Stephens College in its Ideas and Living Today program might well be a solution to standardization. In this course, a team of instructors prepares material to be presented via television. Faculty discussion leaders working with small student groups continue the class work after the tele-lecture. This system provides a basic body of information as does a textbook, but does it in a personal and visual manner. The classroom instructor can then work with the presentation as he deems necessary. The University of Missouri course in general psychology (first college course to be endorsed by the Great Plains Regional Instructional Television Library) provides the user with two tele-lectures each week and suggests that the third hour be devoted to classroom discussion with a local teacher. This type of instruction will probably be more acceptable to most institutions of higher learning. It allows a certain amount of important local control, but makes use of the best television presentations produced elsewhere.

Can savings be effected using a recorded series if a local instructor is also required? The answer is fairly obvious. An instructor on a campus using televised lectures has more time to counsel individually with each of his students because he is not engaged in repetitious lectures. For some students the television lecture might suffice, together with additional reading. Some courses and some students require discussion to consolidate and re-enforce the subject matter. Thus the tele-lecture makes possible a greater variety of situations for the student and makes available to him the instructor whose time was formerly taken by lecturing. Through its own faculty each institution can retain its own character, although using the same recorded materials.[6]

Residual rights and copyrights

This suggested interchange of materials poses another problem, that of residual rights for the instructor. This problem is being considered today by the National Education Association (NEA, Professional Rights and Responsibility of Television Teachers) and is drawing much comment in professional circles. What rights has an instructor in the program that he has recorded? What should his rights be? If he teaches ten thousand students instead of a thousand each year should he receive additional remuneration? Does an instructor have control over where his material will be used? Should he have such control? These questions will become increasingly important in the years ahead.

As more duplication systems are used in institutions of higher learning there will undoubtedly be a greater attempt to control copyright. It is now a simple matter to select a piece of work from a copyrighted text, put it on a transparency, and present it to an entire class. If material copied is not re-sold, supposedly no infringement of copyright has occurred. But how can we determine whether or not a copy which is made results in loss of sale of the copied source? How much material copied from a text constitutes infringement? Certainly, publishers and authors are going to incur losses unless they act.

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[6] A guide to films, kinescopes, and videotapes available for televised use, Second edition, Winter, 1962-63, published by Instructional Television Library Project, New York, New York; Lincoln, Nebraska; and Boston, Massachusetts.

Duplication of material also applies to recorded audio tapes and records, and will soon apply to televised and filmed materials, as video tape recorders become more numerous. Manufacturers are aware that educators as well as home consumers duplicate records and tapes. All the purchaser need do is buy one copy of a tape and he can make as many additional ones as his conscience allows. Duplicates can be made for the cost of the tape alone plus labor, whereas cost of an original tape normally includes a royalty to musicians or other talent appearing on the tape. Large-scale mass duplication is not a problem at present, but certainly on a small-scale there is much duplicated material made from professional tapes, records, books, and other printed sources.

As inexpensive video tape recorders appear, off-the-air recordings of any television program will be possible. The legality of such copying is questionable, and copying for purposes of resale is illegal. These are problems which will increase in scope and number in the next ten years.

Other audio-visual equipment

Although television, because of its scope, deserves special attention, other equipment and systems need to be stressed, because each can contribute to one or more specific educational needs. Each is discussed, not necessarily in order of importance, but in light of availability today and probable use in the future.

Record players.--Record players are common in many college throughout the country. New manufacturing techniques have made possible production of high quality records on discs, smaller, less subject to breakage, and capable of longer play per side. Records today contain music, books, events of historical significance, speeches and, recently, even entire college-level courses. With the trend toward giving credit for knowledge accumulated before entering college, such courses gain in importance for in effect they make accredited independent study possible.

Audio tape recorders.--The first tape recorder was manufactured in Germany in 1935, and quickly improved upon for use in the home market and broadcasting industry. With miniaturization, tape recorders did not replace record players, but did become available in great numbers, especially in the institutions of higher education where ease of recording became almost a necessity. Many educators are advocating that a tape recorder should be as much a part of every instructor's equipment as is a blackboard, eraser, or book.

The recorder enables the instructor to make readily available to his classes the entire range of recorded commercial materials. If recorded materials are not available the instructor can easily make tapes which suit his educational aims. He can record his lectures and give them to any members of the class who need repetition in order to understand clearly what has been said. To play such tapes students use either their own recorders or those provided by the institutions.

One of the major uses of the tape recorder is in the language laboratory. However, resource libraries such as the one at Stephens College are providing audio-visual carrels or individual learning centers for students. In these individual centers students may replay instructor's tapes if the instructor desires to record them and make them available to his students. Or the student might borrow a tape recorder to make a recording of lectures in each class. The miniaturized tape recorder makes possible a book-size unit that can make an acceptable voice recording. These units are not expensive, are relatively simple to maintain, and are easy to carry.

Motion pictures.--Another device that found early favor in educational circles, and has since received renewed importance is the motion picture projector. Important educational audio-visual instruments in the years following World War II, the motion picture projector and films were continually analyzed to determine their impact on society. When sound was added to motion in the twenties and thirties and the 16mm format was introduced, educators opened the doors of the classroom to the world.

With the development of new emulsions, new types of films, and new types of cameras camé the self-made or institutionally produced motion picture, and a great range of educational products was made available to other educational institutions throughout the country. New methods of recording and editing made it possible for amateurs to produce professional films. Programs were developed in institutions of higher learning to train personnel in the art of the motion picture, both aesthetic and practical.

8mm film.--In the past few years finer grain film and new processing techniques have made possible the wider application of 8mm film, which has also become more useful because of its sound capabilities. In the next few years this development will have a strong impact on education. Schools which could not afford 16mm sound cameras and projectors will be able to make their own instructional films on 8mm film at almost half the cost. As more people turn to 8mm film the manufacturers will begin to supply less expensive film, cameras, and projectors, which in turn will increase consumption. Decreased storage space and ease of use, including cartridges which make threading unnecessary, will open new vistas. Again, 8mm is indicative of the trend toward miniaturization and small, compact, light-weight units. While many institutions now feel that it is a luxury to provide a film production unit on campus, there will probably be an increasing number of film production units utilizing the 8mm format.

Slides.--The still picture and filmstrip have also proven useful in education. As black and white and color film, particularly color film, have been developed, cameras simplified, and film and processing costs reduced and simplified, the film camera has been used more widely in instructional situations.

Development of projection screens with higher luminescence and lower cost helped introduce these units into the institutions of higher learning. A fifty-dollar 35mm camera, a one-hundred-dollar projector, a twenty-five dollar projection screen, and some film can put a production unit in any institution.

With special lenses, photo-micrographs can be made utilizing laboratory microscopes.

All these materials can enhance instruction, and can enable the instructor to show pictures of a demonstration, a specimen, a painting, a landscape, or a rock structure, in color, to a large audience. Or the slide can be made available to an individual student on a viewer costing about fifteen dollars.

The 2x2 slide which utilizes film from the standard 35mm camera is the size most likely to be adopted widely in our educational institutions in the future. A number of materials are available on the lantern slide in the 3x4 or 4x5 size. However, these slides will, and should for sake of standardization, become obsolete in the next few years, as remote operated tape-activated 2x2 slide projectors become standard equipment in the university.

At a recent conference, a number of leading DAVI members indicated that, although there is still a need for the larger format pictures, that need is diminishing as more and more materials are made available on 2x2 slides, and as optical systems and films reproduce excellent images suitable for instructional purposes.

Filmstrips.--In addition to the 2x2 slide, the 35mm filmstrip, a series of still pictures on a strip of 35mm film, has many uses. The strip of film is cheap to produce and reproduce. The image projected by a 35mm filmstrip projector is almost identical to that of a 2x2 slide projector. The differences are too minor to discuss here. The advantage of the filmstrip is that it is less expensive than an equal number of pictures on 2x2 slides mounted individually, and that the sequence is fixed and cannot be disturbed by spilling slides or destroying slides in the sequence. There is, thus, better control of the message. However, there is the disadvantage that the filmstrip cannot be edited as easily as the 2x2 slides, which can be intermixed at will and modified to suit each instructional situation. In addition, scratches tend to appear on filmstrips a short time after they are placed in use. Sprocket holes can also be damaged. Manufacturers are developing new projectors and newer emulsions so this problem should be overcome in the future.

Combinations.--Both the filmstrip projector and the 2x2 slide projector have seen new developments in recent years. For a number of years the 35mm filmstrip projector has had available record attachments so that a sound track could accompany the filmed message. This is a cumbersome arrangement at best. Although the system does allow a certain dynamic quality to attach to the filmstrip, included with the message is an audible signal to the operator that the frame should be advanced. It is necessary to include a copy of the script so that the operator can keep picture and sound synchronized. More recently, manufacturers have provided several innovations.

A recent development in visual presentation is the Kalart Company Sound Strip Projector (see Figure 7). It utilizes standard 35mm filmstrips on which the sound track is printed adjacent to the pictures. Thus, pictures and sound are always in synchronization, there is no audible signal, and a minimum number of operational problems. At present, however, local production units must send materials to the factory for processing, an expensive system for local production only, but a low-cost system if a number of filmstrips are to be produced. An obvious disadvantage is that sound and filmstrip can be reproduced on only one manufacturer's piece of equipment.

Another recent approach is that of accompanying filmstrip with a taped commentary. The audio tape contains one channel of information which is replayed as the filmstrip is shown. A second channel on the tape is used to cue the filmstrip so that pictures are advanced whenever the cue track contains the proper information. The cues are not audible so they do not interfere with the message.

There has also been automation of 2x2 slide projectors. Where it was once necessary to advance each slide manually, magazines holding from thirty to one hundred or more slides are now available, and each of these projectors can in turn be controlled by a tape recorder in the same manner used for the filmstrip projector. One channel on the tape contains the message while another contains appropriate cues to activate the 2x2 slide projector. The system is versatile and fairly inexpensive to operate. Required are a tape recorder capable of being adapted for cueing purposes, a cueing electronic device, a motion picture screen, and a camera for taking pictures. In addition slide mounting materials are required if it is desired to protect the slides. It is likely that with rapid processing available, and inexpensive film and systems on the market, the 2x2 tape-activated slide projector system will become widely used in educational institutions.

Another modification of the 2x2 slide system is that which utilizes a slide aperture holder with the tape recorded commentary pertinent to the slide inserted. This system has one advantage in that slides can be intermixed and the message pertaining to each slide will accompany that slide without re-recording. However, the length of the message is now limited to about two minutes. It is more than likely that additional simplifications will be provided as manufacturers turn their research and development staffs to the solution of the problem.

The use of multiple slide presentations is gaining more and more attention. The technique has been used successfully by the armed services in instruction to make comparisons, show relationships and present sequential material. For example, in science a diagramatic presentation may be shown on one slide while an actual photograph is shown on a second slide. In an art class two separate paintings may be shown simultaneously so that relationships can be seen.[7]

The Eastman Kodak Company has developed a relatively inexpensive drum-type, 2x2 slide projector for use in education. Called the Carousel (see Figure 6), this unit holds eighty 2x2 slides and can be remotely operated. At present the unit is not capable of accepting all slide mounts, such as those mounted in standard glass utilizing standard binding technique. The company has manufactured a thin glass mount which can be inserted into the drum. However, most automatic projectors do not function well when slides are used which have been bound with tape. Heat of the projector causes the tape to ooze and the automatic action often catches on the edges of the tape jamming the slide in the projector. These defects can be overcome if metal mounts are used. Stephens College is attempting to standardize its mounting procedure using thin metal Leitz mounts.

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[7] Audio-Visual Notes Volume 63-1, Eastman Kodak Company, Rochester, New York. This free publication briefly describes the use of two-screen projection.

Overhead projector.--The overhead projector casts large 10x10 transparencies on a screen at a high level of illumination so that a room need not be darkened to view materials shown on it. A unique feature of the device is that it enables the instructor to face his class as he works with the unit, for projection takes place over the instructor's shoulder. The projected image appears behind him, but he sees and works with that image on the stage in front of him. The overhead is a versatile unit, for materials can be prepared in advance and overlays can be utilized. The overlay consists of additional information on transparent sheets of acetate placed one above the other. Information can be presented in a predetermined sequence or altered if necessary during a presentation. In addition, professionally prepared materials are usually more legible than an instructor's well-intentioned scrawls on a chalk board.

Hoppmann, Inc. has developed an overhead projector that is also a multi-media unit (Figure 1). Utilizing a minimum number of projection lamps and condenser systems, the device provides overhead projection for large 10x10 transparencies, 2x2 slides, lantern slides, and filmstrips.

Opaque projector.--Opaque materials may be reproduced in the classroom in several ways. The opaque projector, which projects images of small three-dimensional models, individual two-dimensional pictures, or magazine pages, is still in use but is being replaced rapidly. Because the system depends upon reflected light rather than incident light, the projector must be used in darkness, making note-taking relatively impossible unless highly elaborate light systems are installed. Development of fast-operating portable duplicating systems, such as the 3-M Company Thermofax copier, which creates transparencies from opaque materials in seconds, enables use of the overhead projection system which has greater light output. Rooms need not be darkened and the transparency lends itself to more versatile use in instruction.

Technimation.--A fairly recent development is polarization to provide animation on slides and overhead projection transparencies. Utilizing light-polarizing material overlaid on the transparency, and a polarizing spinner in front of the projection lens, the system conveys the illusion of motion on a projection screen. For example, a projected transparency showing circulation of the blood might be animated to indicate direction of blood flow and pulsing action. It is relatively less expensive to construct animated materials in this manner than to produce the same effect using motion pictures. However, this does not mean that technimation, as the process is known, will replace the motion picture. The technimation system at present is not accompanied by a sound track, and the program presentation is not as subject to control as is motion picture film.

Rear screen consoles.--Figure 1 shows the Edling Teachers Console, Model CD-34. This unit, designed by Hoppmann, Inc., is a self-contained filmstrip projector, slide projector and overhead projector with stereophonic sound system. It also projects motion pictures. Projection units are contained in the desk below the large screen, and pictures are beamed through the tube to the rear screen above. Here, again, the unit is most flexible, but screen size is limited. If screen size is not a factor, however, the unit has application.

Laboratory concepts.--The laboratory, once associated almost exclusively with languages, has now been adapted for use in other areas. Perhaps one of the most interesting developments is that of Rich Engineering, Inc. The company has engineered a unit called the Stenomatic-Lab "to accurately gauge typing speed, rhythm, and total the stroke or word count." The unit draws upon several electronic developments, the continuous magnetic tape loop in cartridges for programming, read-out meters and recorders to gauge typing speed and rhythm and record student skill for future evaluation, and the electronic digital computer to control the systems. The system operates without a physical connection to the typewriter.

The Stenomatic-lab, in this instance, not only provides information on rhythm which is exact, and which heretofore could not be obtained, but also enables an instructor to work with larger numbers of students in a laboratory situation. It is evident that this economic factor is one which will help introduce such systems into education. Obviously, the instructor is not replaced, but is enabled to do a better job with more students.

A study carrel unit designed by Sol Cornberg Associates, Inc., incorporates a system for retrieving taped as well as pictorial materials from a central storage area. The student can view a television screen, read books, or dial for information. The unit also contains a typewriter and individual recording facilities.

Teaching machines.--Some of the new media have acted as catalysts to investigations of the learning process. One such device is the teaching machine which was introduced in the twenties, but has received full attention only within the past few years. Information on the teaching machine is covered in another chapter in this book. It is enough to say that as an audio-visual device the teaching machine has created a stir in educational circles, and has given us new insights into the learning process because of its very nature.

Systems approach.--Figure 17 shows the heart of the Edex system, the teacher console, the projector, and individual student response boxes. It is possible with this system to place a taped lecture on the teacher console which contains cues for an accompanying slide presentation. When the unit is placed into operation students hear the lecture over the amplifier system, view on a screen the related visual materials, and answer test questions utilizing response boxes at each student position. Test scores can be computed individually, or can be totaled immediately, and the cumulative percentage of understanding can be shown on meters on the console. It is possible to project entire teaching machine courses on this unit.

Information retrieval.--Information retrieval systems of the future will be more compact, more reliable, and simpler to operate. An example of such a retrieval system is the Bell Telephone Laboratories, Inc. development called ECO. Although this system will not be mass-produced until 1965, its existence was announced five years ago. In place of the present relay system for dial telephones, requiring innumerable relays and miles of interconnecting wires, ECO utilizes a gas discharge tube or a solid state system. Gas in the tube can conduct electricity and be triggered rapidly from conduction to non-conduction state. This tube provides a memory system that can store several million pieces of information. When a user dials his telephone connections are made with the called party almost instantaneously. The unit scans all phone lines in a central office several hundred times a second.

Industrial developments such as these can have a profound influence on educational media in the future. It is entirely conceivable that such devices might be used as retrieval systems for audio and visual materials placed on tape in a library located centrally in the nation. Participating educational institutions, by dialing code numbers listed in a directory, might retrieve any recorded information from the storage area. Tapes of speeches, current events, great music, etc., could be stored in such a central library and be available immediately in any classroom in the country via a telephone network. When slow-scan or other kinds of television devices are perfected, video material could be sent in very much the same way. Costs of such an operation could be distributed among the many institutions being serviced. A unique feature of the Bell ECO system is that billing information can be included as part of the system. Thus the calling school could be charged automatically.[8]

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[8] Business Week, November 19, 1960, pages 112-116.

Case Study--The Stephens College Learning Center

Use of the new media has resulted in construction of a number of new physical plants. The James Madison Wood Quadrangle (the Learning Center at Stephens College) was the first to be completed and to be made available for the introduction or development of new concepts. Costing three million dollars and adding almost 150,000 square feet of instructional space, the center is equipped with new media as units are placed on the market, and serves as a testing ground for new equipment in which manufacturers might be interested. Such centers as this one should suggest new pieces of equipment which might be useful in education.

Most important, the college recognizes that the combination of exploding costs, enrollment, and knowledge makes the development of new approaches to education absolutely necessary, or the quality of education will suffer. The center provides the equipment, climate, and encouragement for this development. The administration and faculty work together to provide the necessary program to utilize these resources.

Stephens College has a long history in the support and adoption of new media. The college built a radio broadcasting station in the early twenties to disseminate religious programs in the community. In 1934 it introduced a broadcast curriculum for student training. Before World War II a language laboratory consisting of record players and headsets was installed for use by the language department. In the late forties and early fifties the college sponsored a series of national audio-visual conferences related to the use of audio-visual media in institutions of higher education. Each of the college presidents from James Madison Wood to Seymour A. Smith has supported a strong audio-visual program. Under guidance of such educators as W. W. Charters and present Dean of Instruction James G. Rice, the faculty have often led the way in encouraging and introducing new audio-visual techniques.

Amplified telephone.--To illustrate, one of the more recent developments on the Stephens campus has been the use of the amplified telephone.

Long recognized in the business community as a method for holding executive meetings without the necessity of traveling from city to city, the amplified telephone provides a ready means for bringing guest lecturers to campus. An experiment indicated by James A. Burkhart in the 1958-59 school year developed into a proposal to the U. S. Office of Education, and a grant to experiment further with the amplified calls, extending the technique into the fields of philosophy, literature, business education and American government. In his report to the U. S. Office of Education following the experiment, Burkhart noted that,

> The object of this proposal was to determine whether amplified telephone interviews with significant people could enrich certain college courses. In addition, the experiment sought to determine whether current scholarship, along with contemporary social and scientific developments, could be integrated by this method into college courses. It was also thought that the technique would motivate the student by making him responsible for a considerable portion of the interrogation. Finally it was hoped to discover whether individuals who could not be brought to the campus because of their current commitments, or because of the expense involved, could be made available to students at a reasonable cost. (Burkhart, 1961.)

What concerned Mr. Burkhart was, as he put it,

> Despite great emphasis upon new methodology and new media in education, there still remains a tremendous gap between the developing scientific technology outside the school and the exploitation of that technology within the classroom. A time lag of a decade or more occurs between the availability of a new technological device and its classroom application.[9]

The experiment proved so successful that a new grant in September, 1963, enabled Stephens to set up an amplified telephone system linking together Stephens College and ten other institutions of higher education who participated in courses taught by amplified telephone. Other colleges and universities are improving upon the technique. It is conceivable that amplified telephone courses will eventually be held on a national network basis, enabling many institutions to obtain resource personnel at minimum cost for the institution and minimum inconvenience for the resource people. As video telephone develops, and as telephonic pictures become as simple to transmit as audio messages, this system opens up an entirely new range of televideo communication in education.

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[9] Some of the people interviewed utilizing the amplified telephone included Charles H. Percy, Thruston Morton, James A. Farley, Chester Bowles, Governors Mark O. Hatfield, Edmond Brown, G. Mennen Williams, and David Lawrence, Barry Goldwater, Erwin D. Canham, George Romney, Mrs. Mary Roebling, Kenneth Newland, and Mrs. Margaret Hickey.

The above example serves to illustrate how administrative encouragement of faculty to experiment can result in new media usage.

Learning center systems.--The heart of the learning center audio-visual system is a coaxial cable distribution network. All classrooms and many dormitory spaces are connected to a master control system. Master control is a television, radio, and film center connected by conduit with a resources library. Cables placed in the conduit carry information to and from any of the spaces on campus, from individual learning centers or carrels to classrooms, dormitories, and large auditoriums. Live, filmed, taped, or slide programs are distributed from master control to any point on the campus simultaneously. From radio studios and from master control an infinite number of stereophonic FM music or voice broadcasts may be programmed. Students and faculty have access to films, tapes, slides, and other audio or visual materials when preparing papers and reports. Students can check out these materials for use in the library or in the dormitory. To encourage use of the entire range of materials, devices are provided which are relatively simple to operate and available to the student. These devices are durable and deliver a high-quality sound or picture.

Because much of the equipment on the market today is not yet as simple to operate as it should be, some training sessions are necessary for students and for faculty so that equipment is operated at maximum efficiency with minimum effort. So-called "economy" equipment has been rejected on the basis that it deteriorates more quickly, is less durable and seldom performs as satisfactorily as an instrument of better quality.

The Stephens College Learning Center points up the necessity for planning campus construction so that all spaces can be utilized for television reception and for instructional purposes.

Figure 2 depicts the artist's conception of one of the new control rooms looking into a television studio.[10] Control rooms in the learning center have been constructed to serve not only as production centers but as classrooms. These control areas are large enough to seat students taking courses in television production.

In Figure 9 are depicted three important units in the learning center classrooms. On the wall at right is the audio-visual control panel which contains a stereophonic amplifier system and controls for classroom lighting, remote operation of filmstrip, slide and motion picture projectors, and on-off and channel selection for the television receiver. Next to this control unit is the audio console containing a stereophonic record player and a stereo tape deck for recording and playback. These units both operate through the classroom sound system. The stereo deck contains a head configuration which enables an instructor to play back pre-recorded and pre-cued monaural or stereo tapes which can trigger any of the electronic systems in the classroom such as a slide projector or a filmstrip projector. The instructor can record his lecture for students who may be absent. A third module at the left of the drawing is a desk containing a Hoppmann multi-media projector with filmstrip and slide attachments to enable use of transparencies, films, or slides from the teacher's desk. All of these units have been designed for the college by Hoppmann, Inc.

Another view of the classroom is shown in Figure 10. Here the instructor is using dual projection to compare a traditional and modern painting. The two projectors at the rear of the classroom are controlled by the remote panel at the teacher's desk. To save classroom floor space and provide a better viewing angle, the television receiver is suspended from the classroom ceiling. In each corner of the classroom are speakers designed for monaural or stereo reproduction of sound and music. The college selected front-screen projection for its classrooms because of the brilliance and size of the image which can be obtained.

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[10] Mrs. Dorothy Heibel, graphic artist at Stephens College, has provided an artist's conception of some of the units which have been placed in operation in the learning center.

Figure 11 depicts one of the six stereophonic listening and viewing rooms in the Learning Center Resources Library. On the audio-visual floor of that library these rooms are available for students to listen to playback of recorded music and material distributed from master control on the coaxial cable system. This includes television as well as audio programs. Each room is equipped with a Magnavox stereophonic console permanently installed.

Available at the library audio-visual check-out desk are lightweight, small, portable television receivers which can be carried into the listening-viewing rooms for use. The portable units can also be used with headphones at any of the library tables which have been connected into the coaxial system.

The audio-visual floor of the library is criss-crossed with ductwork so that automated individual learning spaces can be provided as needed in the future without exposed wiring.

Listening tables are provided in the Resources Library on which the instructor can program materials for his students. Listening tables consist of a series of programmed inputs into which taped or recorded materials may be played continuously or on schedule. These materials are picked up at listening stations at the table. At each student position is a volume control, a headphone, and a program selector which enables the student to select any number of programs that might be prepared for the table. At Stephens tables have been constructed with six program inputs. Programming may emanate directly from the table where tape recorders and record players are provided for individual student manipulation. In addition, program lines from master control are provided so that programs can be disseminated to a number of locations simultaneously. Such programs include commercial tapes and tapes made by the faculty at the college for various course purposes. It is also possible to present programs from foreign nations picked up on shortwave radio and retransmitted on the coaxial cable or audio lines to the listening stations or listening table.

Figure 12 depicts the three hundred seat assembly hall equipped for stereophonic or monaural reproduction of music, and with audio-visual lecterns similar to the teacher's desk in the classroom. From these lecterns the instructor can control lighting, the motorized screen on the stage, and any of the motion picture projectors, slide projectors and filmstrip projectors in the projection booth at the rear of the auditorium. For future installation, conduit has been provided so that each seat can be wired for response mechanisms. Such response systems as that manufactured by the Edex Company will enable students to respond to instructor's questions and give the instructor an indication, immediately if necessary, of student reaction to his lectures and understanding of his content.

One of the more unusual pieces of equipment in use on the Stephens College campus is the Perceptoscope, manufactured by the Perceptual Development Company, St. Louis.

This unit is a projector which shows 16mm film, both single frame and motion, in any sequence on pre-set cues. The language department has prepared visual materials for the projector for use in Spanish and French classes. A typical film may contain a series of still pictures depicting various objects. As the student views each frame, he records on tape in the language he is studying, his pronunciation of the object. As the lesson progresses and motion becomes necessary to convey a meaning, that motion appears on the same strip of film. The combination of stills and motion enables the instructor to control his content with a single projector.

Another program for the Perceptoscope was prepared by a member of the art department who wished to show his students the geometry of the human head. The film consists of single stop frames and segments of animation in which a sculptured head is reduced to a single block and returned to a head once again. The instructor found in his experimental sections that learning took place much more rapidly, and that the concept he was trying to teach was understood more readily by his students than in sections which did not use the film.

The college uses 8mm film both to instruct students and to provide instructors with a method of creating visual materials for their classes. Cameras using 8mm film are now being issued upon request to faculty members along with the appropriate amount of film and necessary processing. It is likely that 8mm cameras will eventually be issued to students for research projects. Motion pictures have been submitted as theses in some institutions of higher learning.

Looking to the Future

The foregoing brief overview of new media is merely illustrative of the burgeoning systems and related problems in the utilization of technology in education. Two factors loom as obstacles to future development of media for education: standardization and financing.

Standardization.--Electronic and mechanical equipment for educational purposes has shown a decided lack of standardization. For instance, there are many inexpensive educational videotape recorders, none of which can interchange with the other.

Since approaches to educational methodology vary, it is difficult for the manufacturer to develop an instrument which will be used universally by educators and which must be used universally if the manufacturer is to recoup his development costs. As a result, so-called audio-visual lines which many manufacturers sell are merely adaptations of home or industrial equipment. The 16mm motion picture projector used in classrooms has the noisy elaborate system of the 35mm motion picture projector which is used in enclosed theatre projection booths. Although Bell and Howell has developed a self-threading 16mm projector, the system operates as does any standard projector insofar as complicated threading path, sprocket holes, and sound head are concerned.

A manufacturer interested primarily in the educational market might develop a noiseless projector which could be used in the classroom without interfering with the message. This machine could be a slot-load cartridge device requiring no threading. The Technicolor Company has such a unit on the market accommodating 8mm film and is simple to operate. However, 16mm film projectors of this type do not yet exist.

As John W. Wentworth of RCA suggests, the manufacturer might develop a building block system so that if the institution wishes to have amplified speech it installs an amplifier and speaker capable of voice reproduction. To add a facility for playing records, a motor and turntable unit are attached to the first unit for playback of recordings. Another unit would enable replay of magnetic tapes. A third unit utilizing the same basic system would incorporate a playback mechanism for motion picture film. Each of these blocks would be simplified plug-in units enabling the educational institution to purchase facilities as needed without spending extra money for unnecessary amplifying and speaker systems.

Financing.--At Stephens, as at many private institutions, one of the most difficult administrative tasks is finding funds to support new development. The introduction of the use of media systems in education calls not only for new thinking about the structure of education, but reconsideration of the financing necessary to implement this new type of instruction. We now speak in terms of millions of dollars when building educational structures. In the future we should consider spending hundreds of thousands of dollars for equipment. J. Lloyd Trump and Dorsey Baynham, in a publication entitled "Focus on Change, Guide to Better Schools," a project supported by the Fund for the Advancement of Education and the Ford Foundation, graphically showed that whereas industry years ago spent 75 per cent of its funds for buildings and 25 per cent for equipment (and education did the same) industry now spends 25 per cent for buildings and 75 per cent for equipment, while education still retains its earlier pattern in spite of the automated systems available today.

There is now a trend toward making available to instructors the entire range of equipment necessary for excellent teaching. We need to convince ourselves that a larger percentage of operating dollars should be expended for this equipment.

The Department of Audio-Visual Instruction is now preparing standards for audio-visual equipment for an institution. This information (the first formulation was made at the national DAVI Convention in Denver, Colorado in 1963) is presented as a tentative recommendation (Table 1).

As studies prove the value of visual and audible materials in the classroom, additional support will be given to the move to equip all of our classrooms better.

The classroom of the future might contain, either separately or in "building block" combination, a tape recorder, overhead projector, reproduction unit, motion picture projector, slide projector, filmstrip projector and stereophonic reproducing system. These systems will be expensive but much less expensive than today's systems, for there will be more of them, there will be an expanded market, and manufacturers will be able to produce these systems at lower cost specifically for the educational market. Such systems will continue to be miniaturized, simplified, and less subject to failure.

According to Stasheff, Professor of Speech at the University of Michigan and Coordinator of the Instructional Television Project, MPATI, in the next twenty to thirty years instructional television (organized credit courses), whether open or closed circuit, will expand even more rapidly than educational television as we know it. Although educational television will continue to grow, its audience is limited. Studies show that the average person, with or without a college education, prefers to watch television for relaxation rather than for enlightenment. On the other hand, instructional television (parts of structured courses or entire courses taught in a systematic manner) will continue to grow as educational institutions grow. Stasheff predicts also that we will see greater use of television at the college level than at the secondary or elementary level.

He also believes that television will make geographical changes on campus; that space will be utilized differently. This is already evident on the Stephens campus where instructional television is transmitted to dormitories as well as to classrooms.

The recent publication, "New Media in Higher Education" (Brown and Thornton, 1963), provides an insight into the future by citing case studies of projects utilizing the media available today. Almost one hundred descriptions of the ways in which audio-visual devices and systems have been used appear in the book, showing that institutions of higher learning are thinking about the future.

There are several important elements involved in using the new media. There is, first, the equipment which includes devices for storing information, reproduction, and dissemination. Second is the physical environment in which the equipment is used--light, temperature, seating and relationship of areas. Third is the "human climate," and those factors which determine the degree to which role change might be accepted without fear on the part of the user--faculty member, administrator, or student.

Finally, there is the entire learning process and the necessity for knowing more about how equipment, environment, and the human factor blend to make learning possible. All are now being given rudimentary attention, and progress is evident in isolated areas throughout the educational community, but we are on a new frontier and much additional time, attention, and money are needed to explore the media wilderness.

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Table 1.--Table of Tentative Equipment Ratios Based on Equipment Units per Teaching Station

Equipment	Units per Teaching Station
8mm Sound Projector	1
8mm Camera	1
16mm Sound Projector	1 to 5
Film Strip Projector	1 to 15
2x2 Slide Projector	1 to 15 (at least one of these should be remotely operated)
Projection Stands	as needed
3-1/4x4 Slide Projectors	2 to 10 units per institution
Overhead Projector	1 to 3 (Note: these should have a 10x10 stage and be accompanied by appropriate carts; at least one unit be portable)
Opaque Projector	2 to 10 units per institution
Tape Recorder	1 to 5 (Note: these should be dual speed, minimum 7-inch reel)
Record Player	1 to 10
Transcription Player	1 per institution
AM-FM Radio	1 to 40
TV Receivers	As facilities and needs dictate
Closed-Circuit Television	Minimum of one portable unit, one equipped studio desirable (Note: all new construction should include provision for installation of CCTV at each teaching station)
Electronic Language Laboratory	1 unit per language department with adequate number of stations to be determined by the department
Darkening Facilities	1 to 1
Permanent Mounted Screens	1 to 1

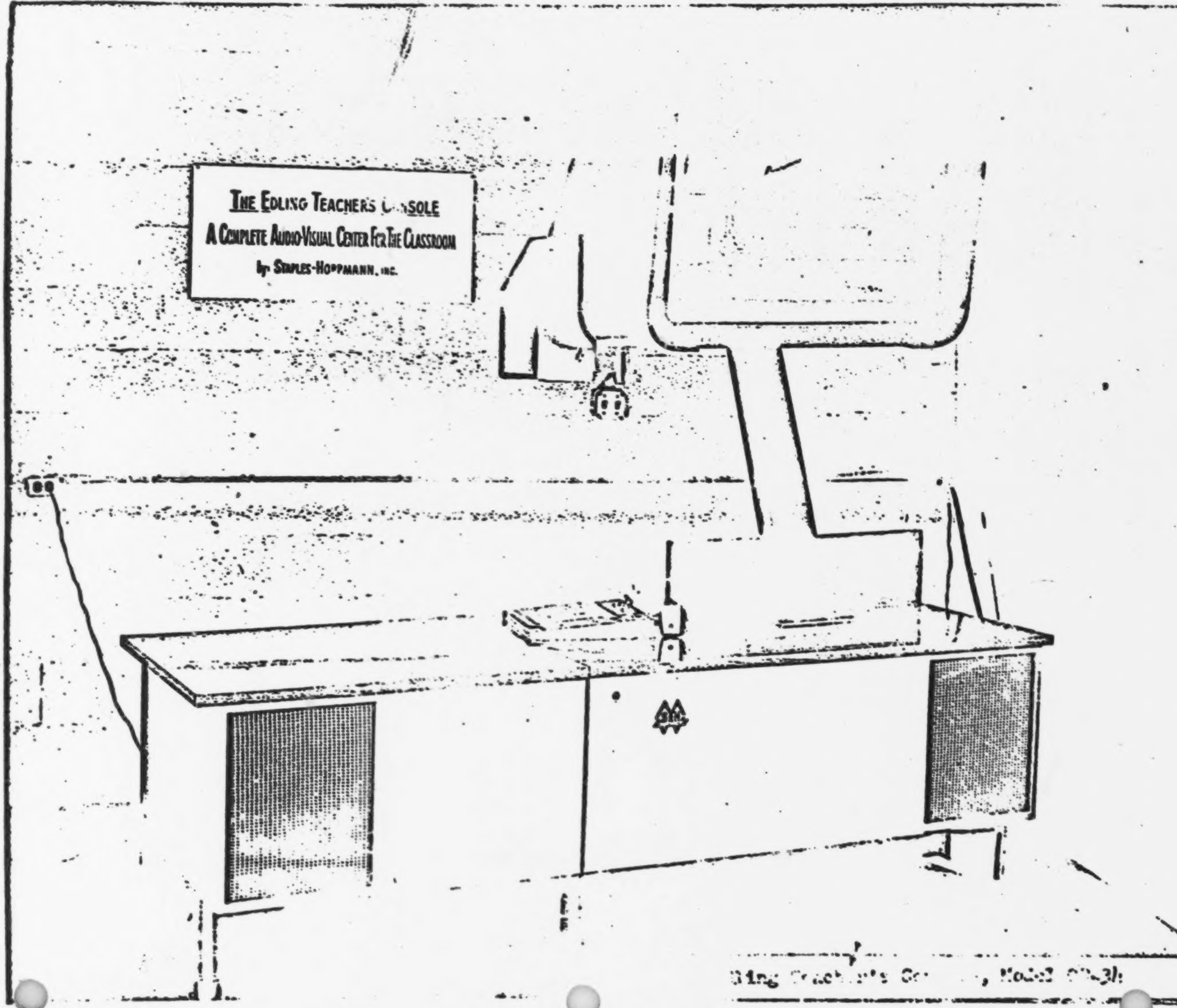

THE EDLING TEACHERS CONSOLE
A COMPLETE AUDIO-VISUAL CENTER FOR THE CLASSROOM
by STAPLES-HOPPMANN, INC.

Figure 1. Edling Teacher's Console, Model CD-34 Courtesy: Hoppmann, Inc.

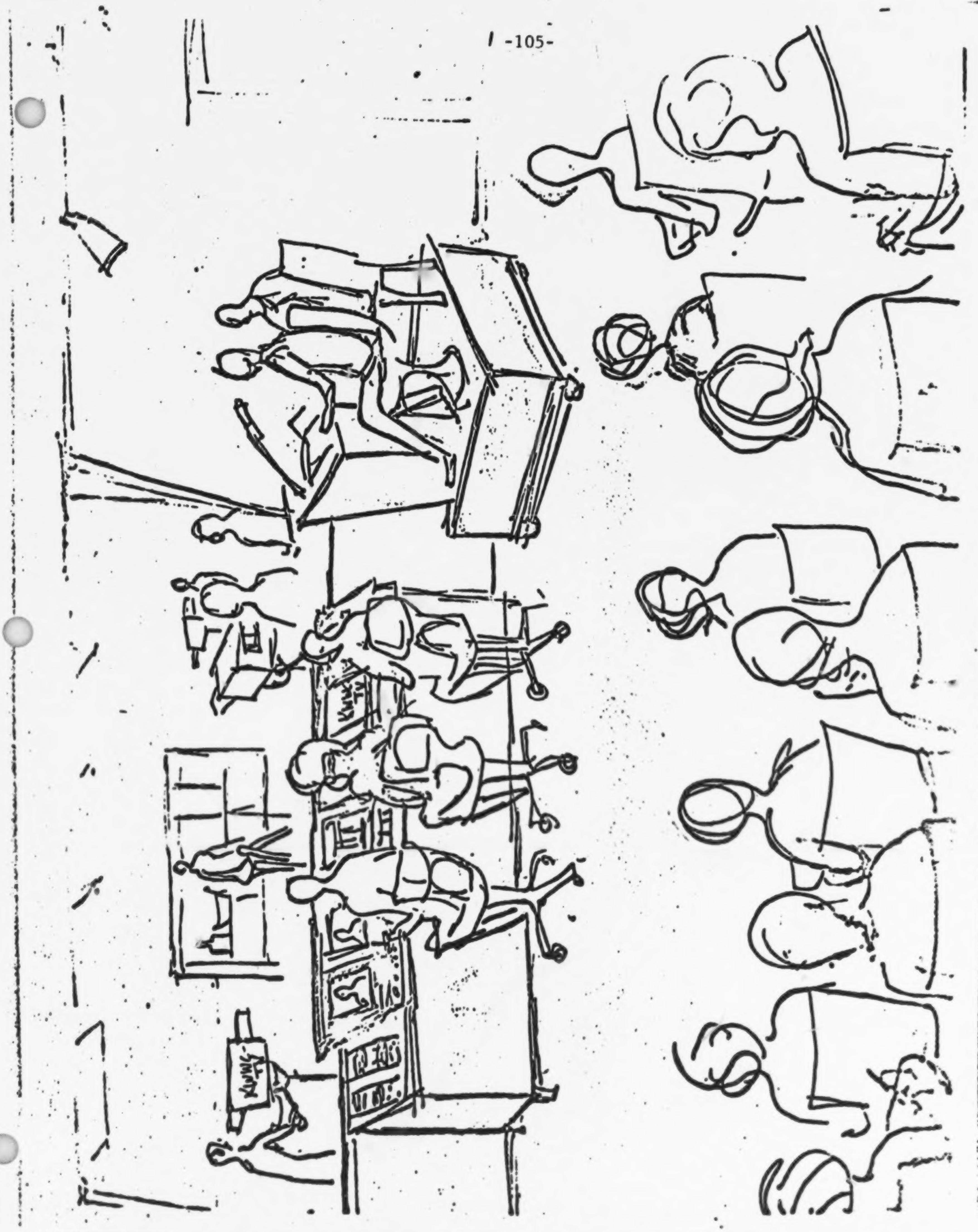

KWWC-TV
KWWC TV

Figure 2.--Control Room, Television Studio A, James M. Wood Learning Center, Stephens College.

Courtesy: Mrs. Dorothy Heibel

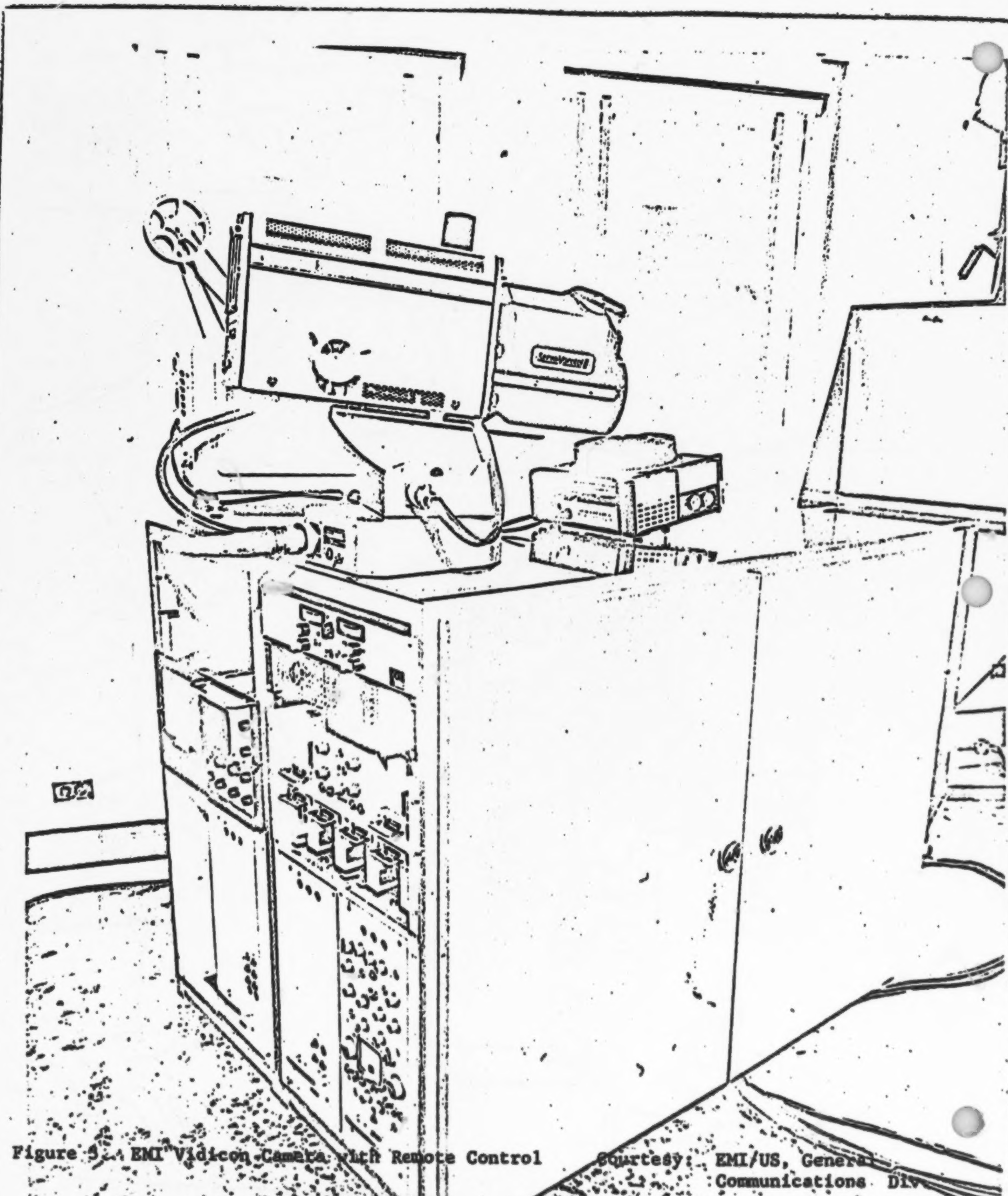


Figure 5 . EMI Vidicon Camera with Remote Control   Courtesy: EMI/US, General
Communications Div

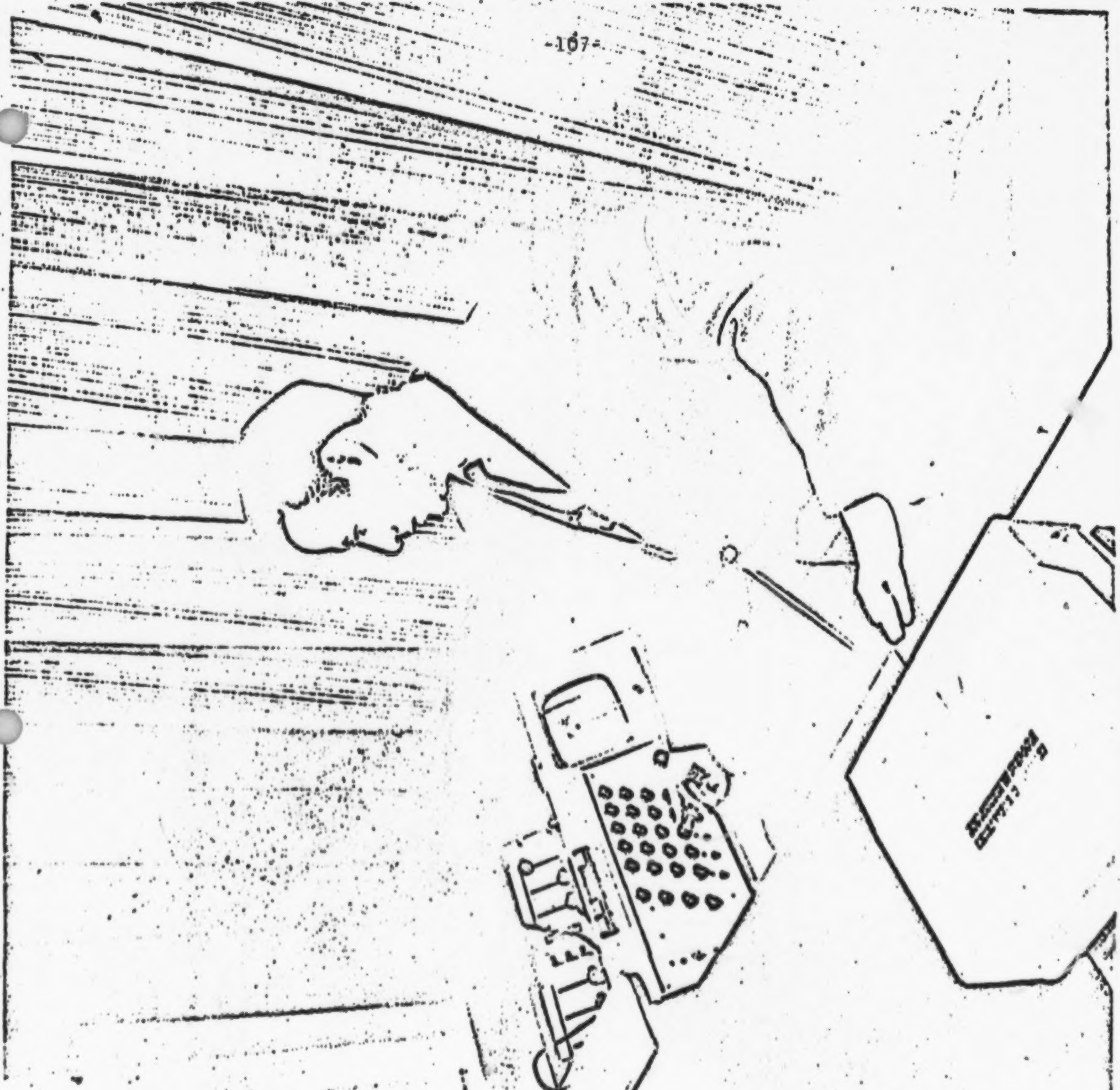


Figure 4.--EMI Remote Control Panel Courtesy: EMI/US, General Communications Div.

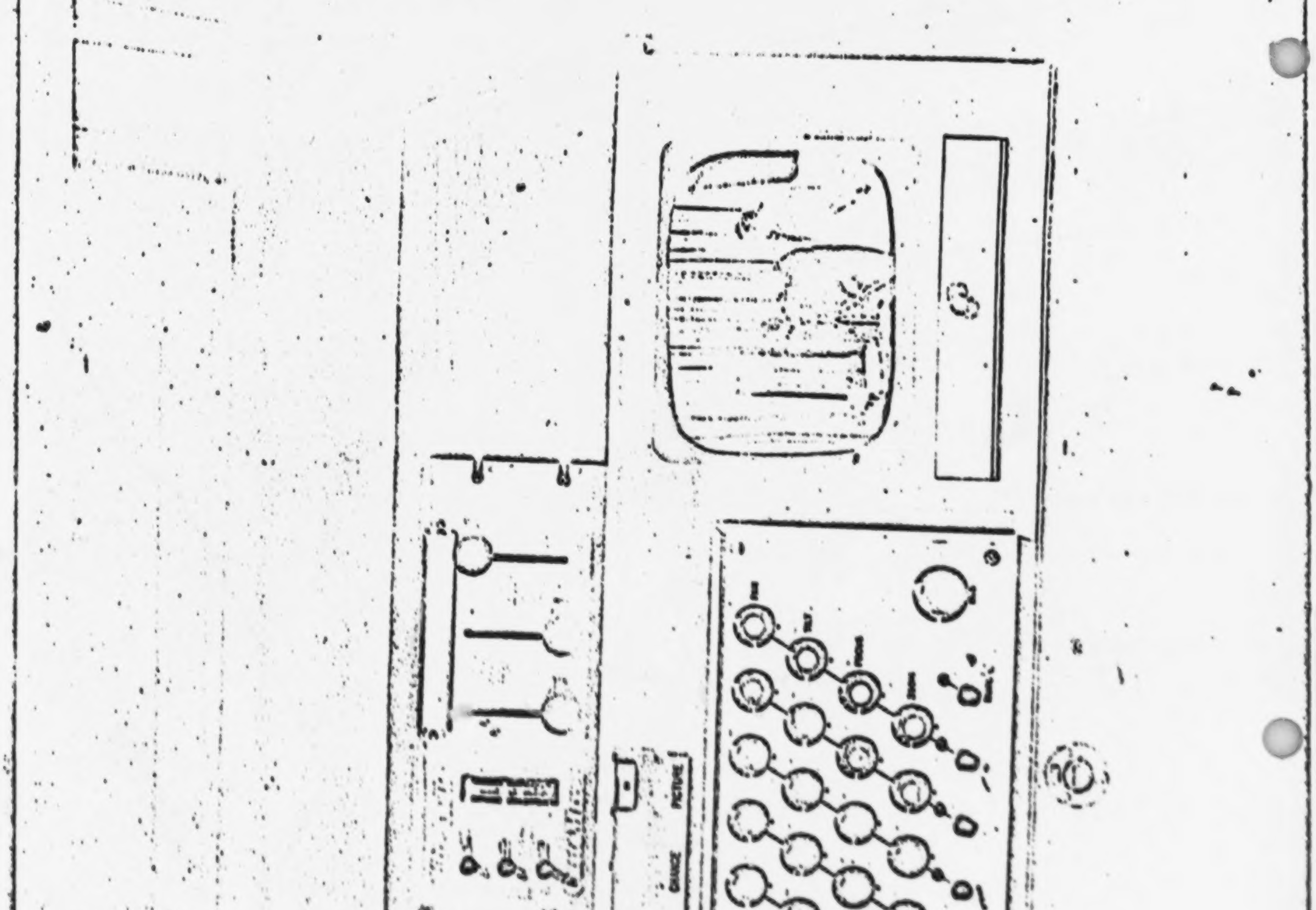

FILM
SLIDE
CHANGE
PICTURE

Figure 5.6--EMI Remote Control Panel, Close-up   Courtesy: EMI/US General Communications Div.

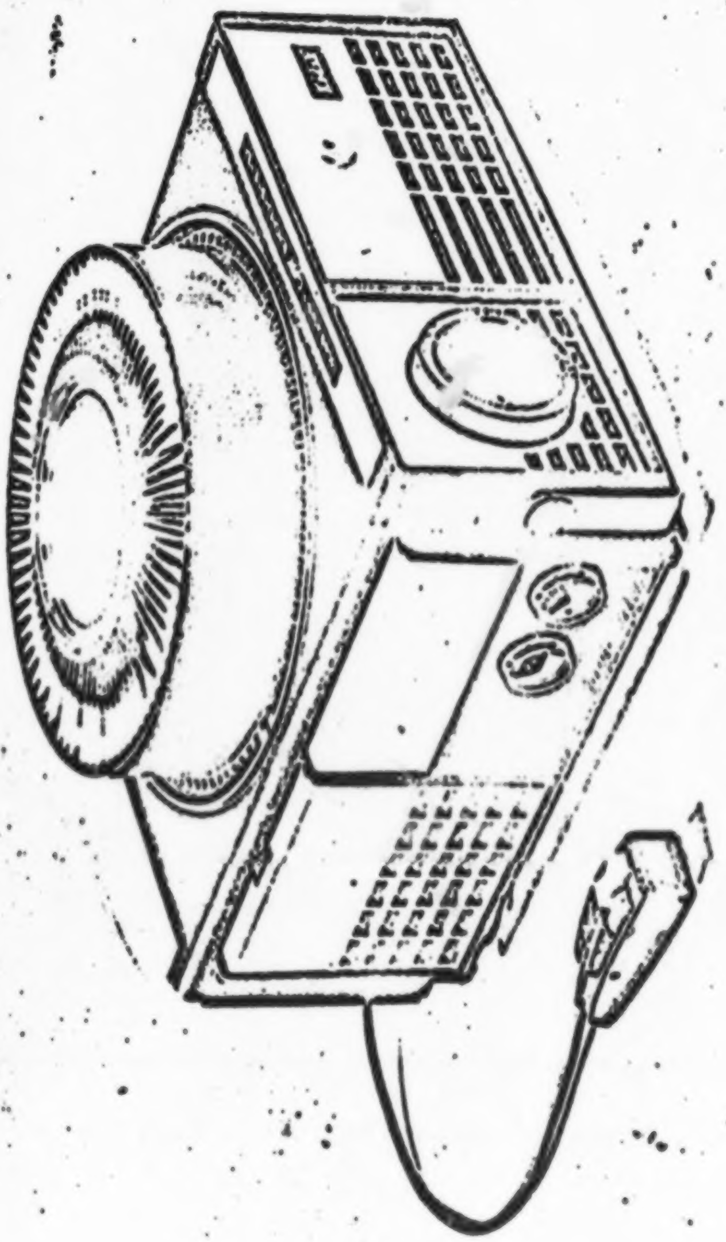


Figure 6.--"Carousel" 2x2 Automatic Slide Projector with Remote Control
Courtesy: Eastman Kodak Co.

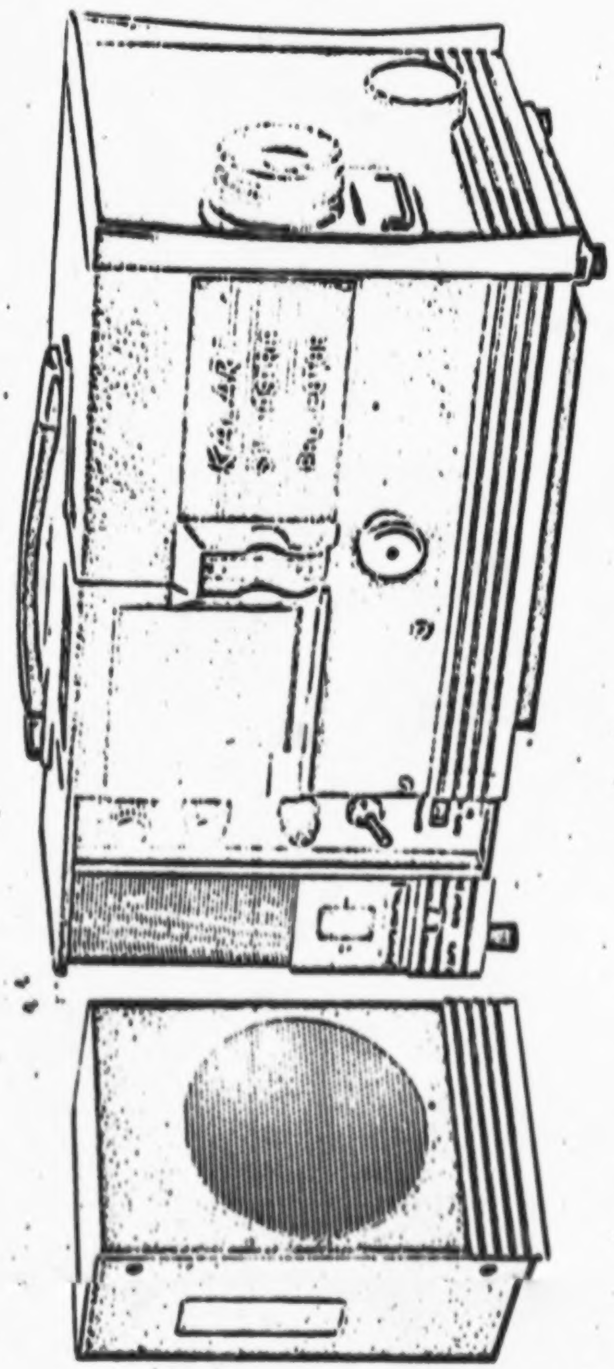


Figure 7.--Soundstrip Projector Courtesy: The Kalart Co., Inc.

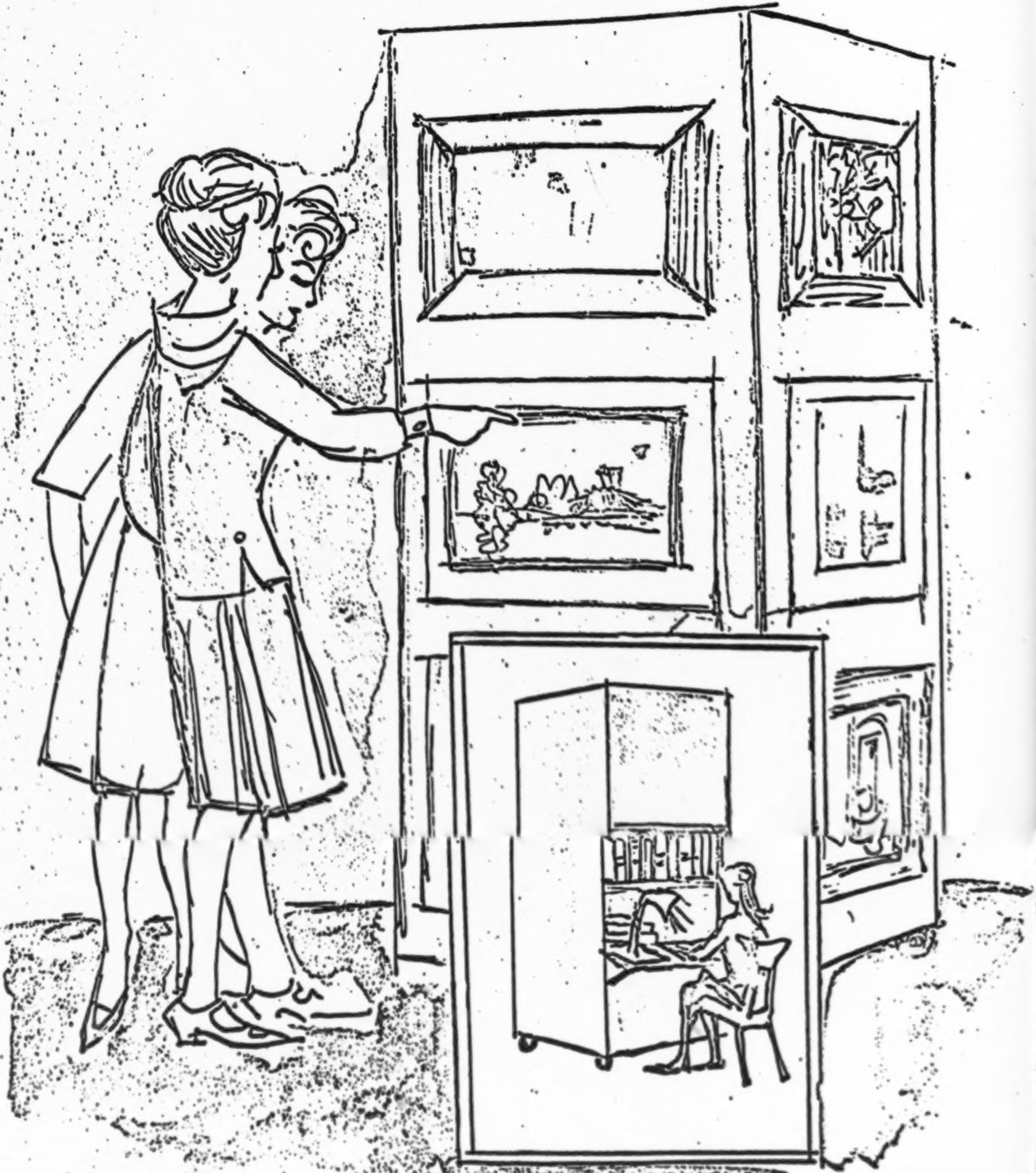


Figure 8.--Display Carrel, James M. Wood Learning Center, Stephens College

Courtesy: Mrs. Dorothy Heibel

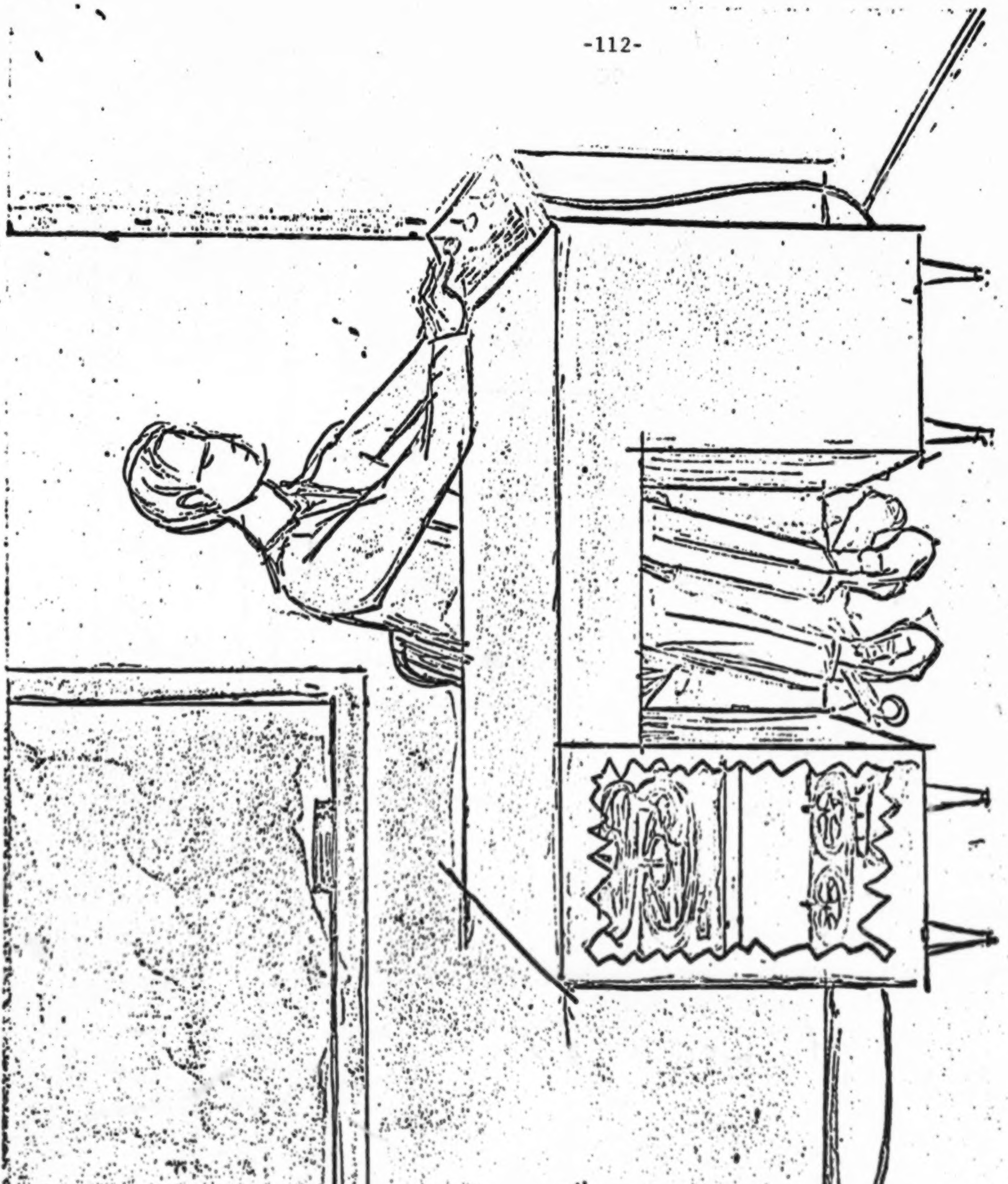


Figure 9.--Audio-Visual Control Panel, Desk and Overhead Projector Module, James M. Wood Learning Center, Stephens College

Courtesy: Mrs. Dorothy Heibel

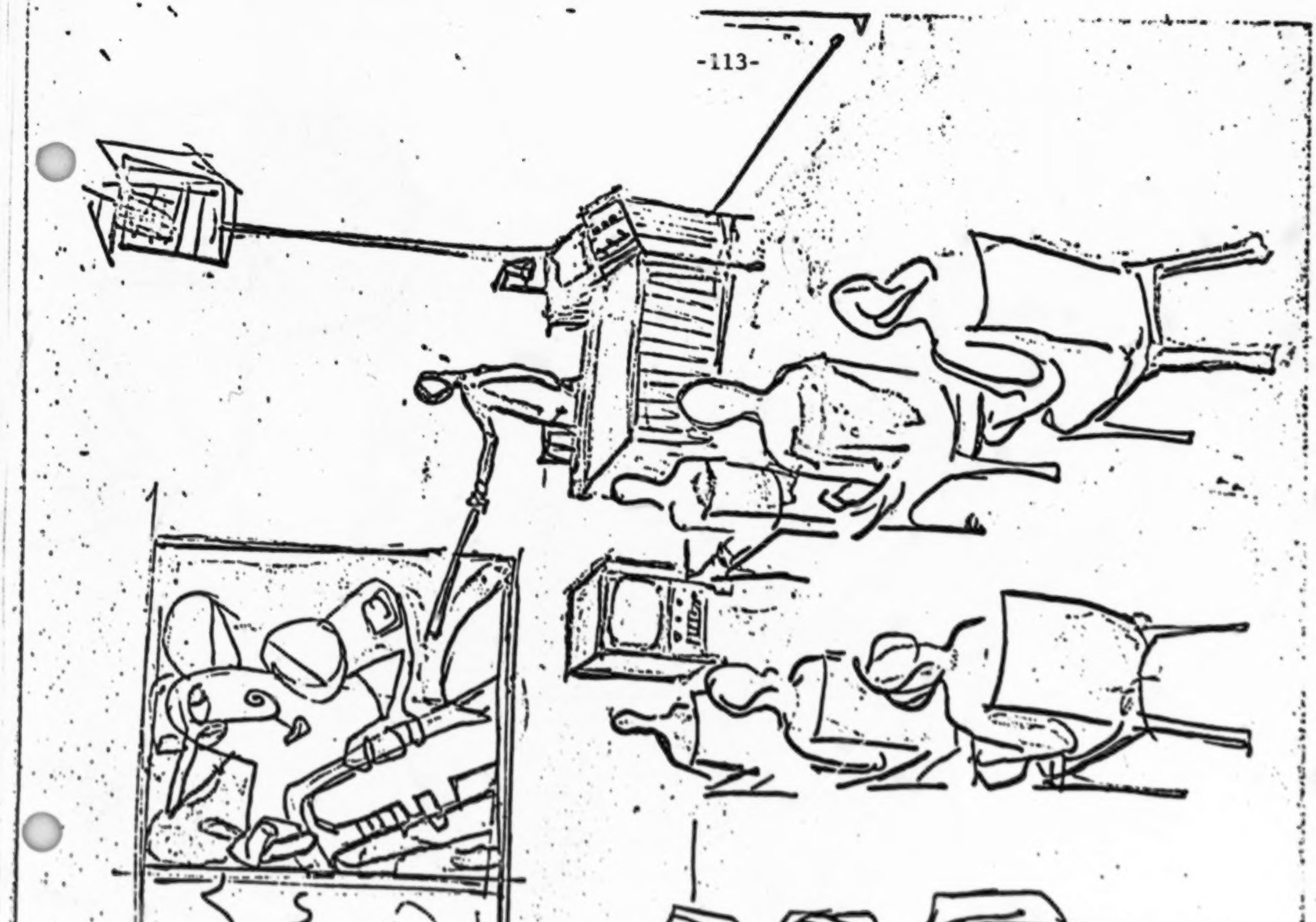


Figure 10.--Classroom, James M. Wood Learning Center, Stephens College

Courtesy: Mrs. Dorothy Heibel

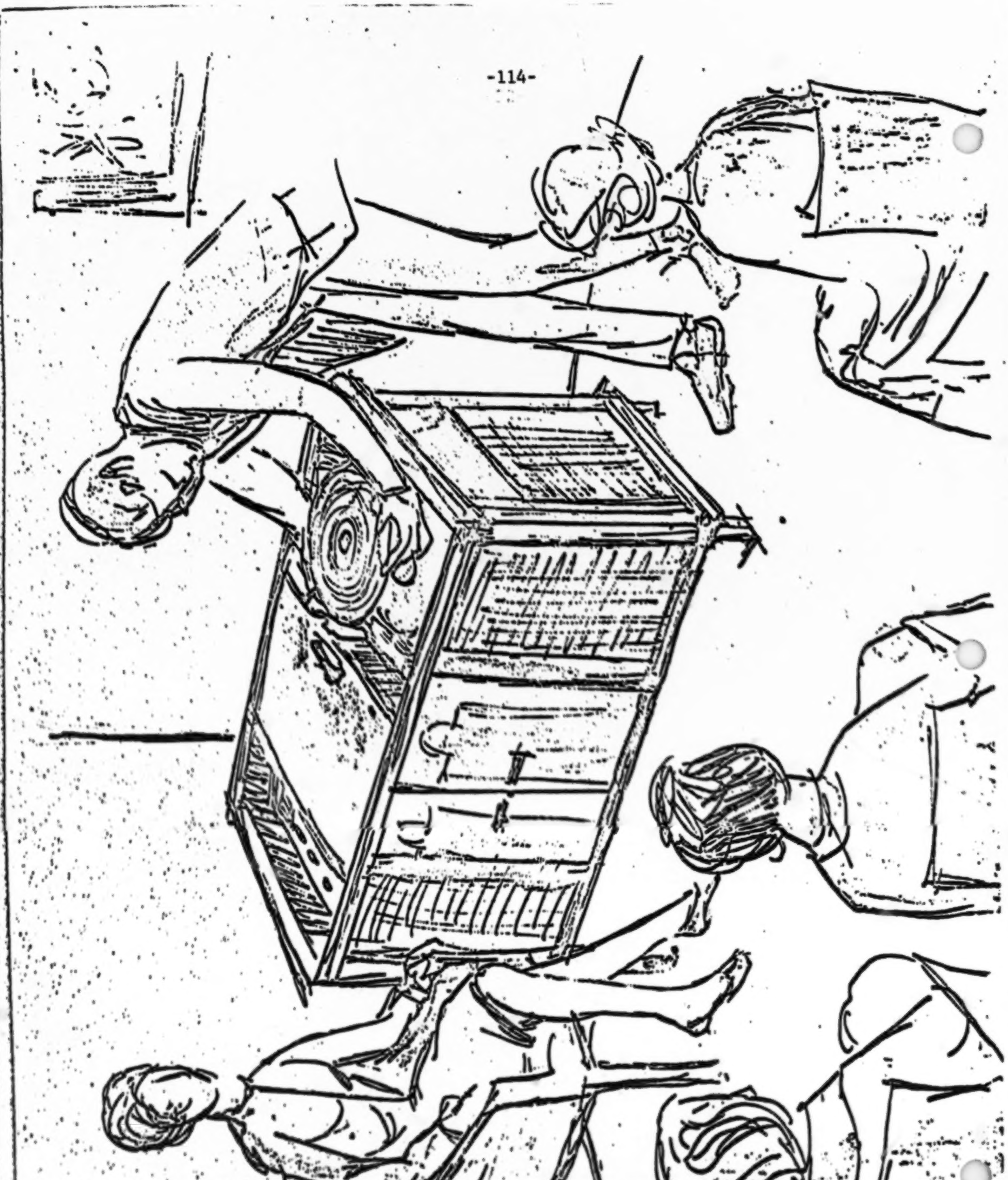
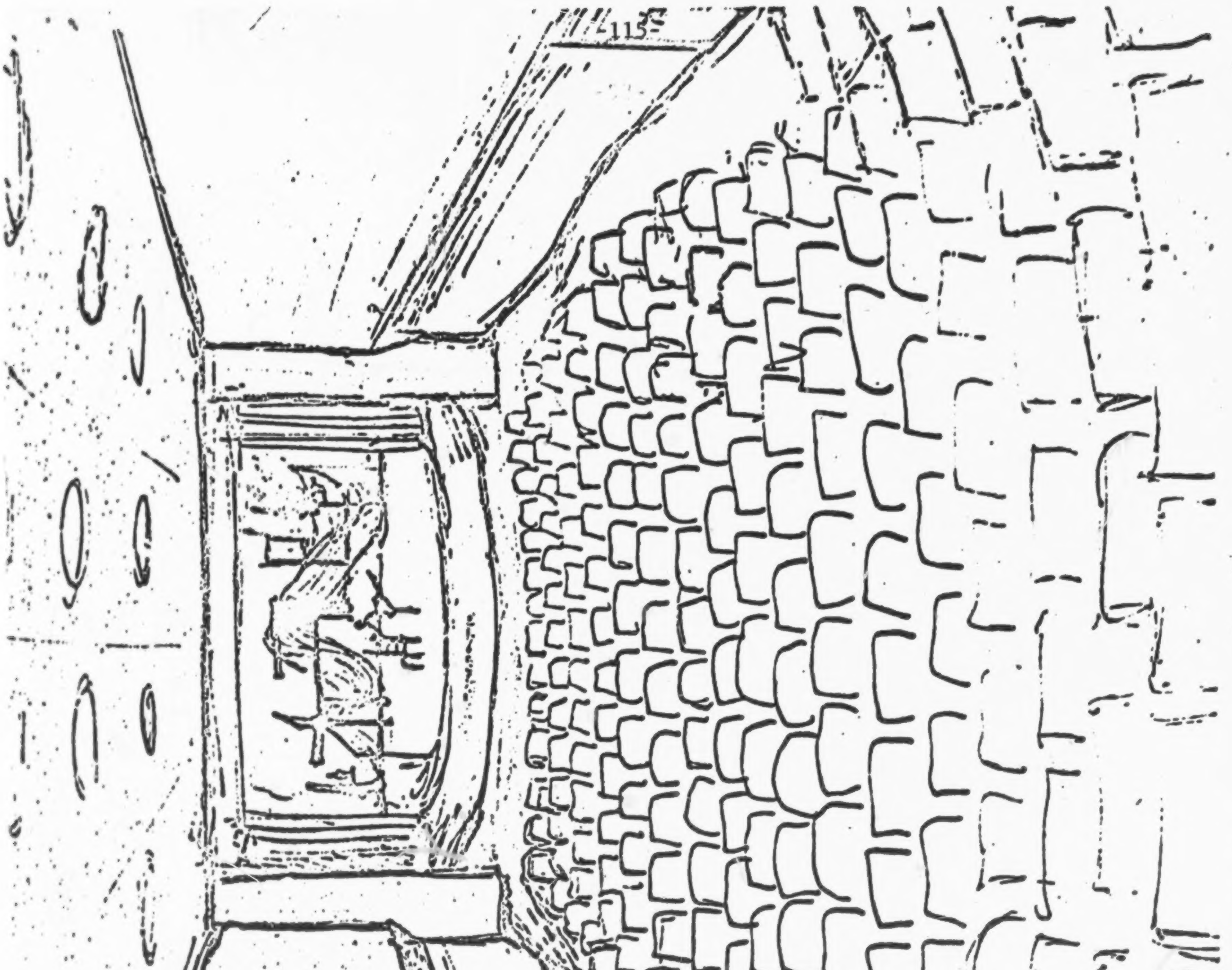


Figure 11.--Stereophonic Listening/Viewing Room, James M. Wood Learning Center, Stephens College

Courtesy: Mrs. Dorothy Heibel



igure 12.--Assembly Hall, James M, Wood Learning Center, Stephens College

Courtesy: Mrs. Dorothy Heibel

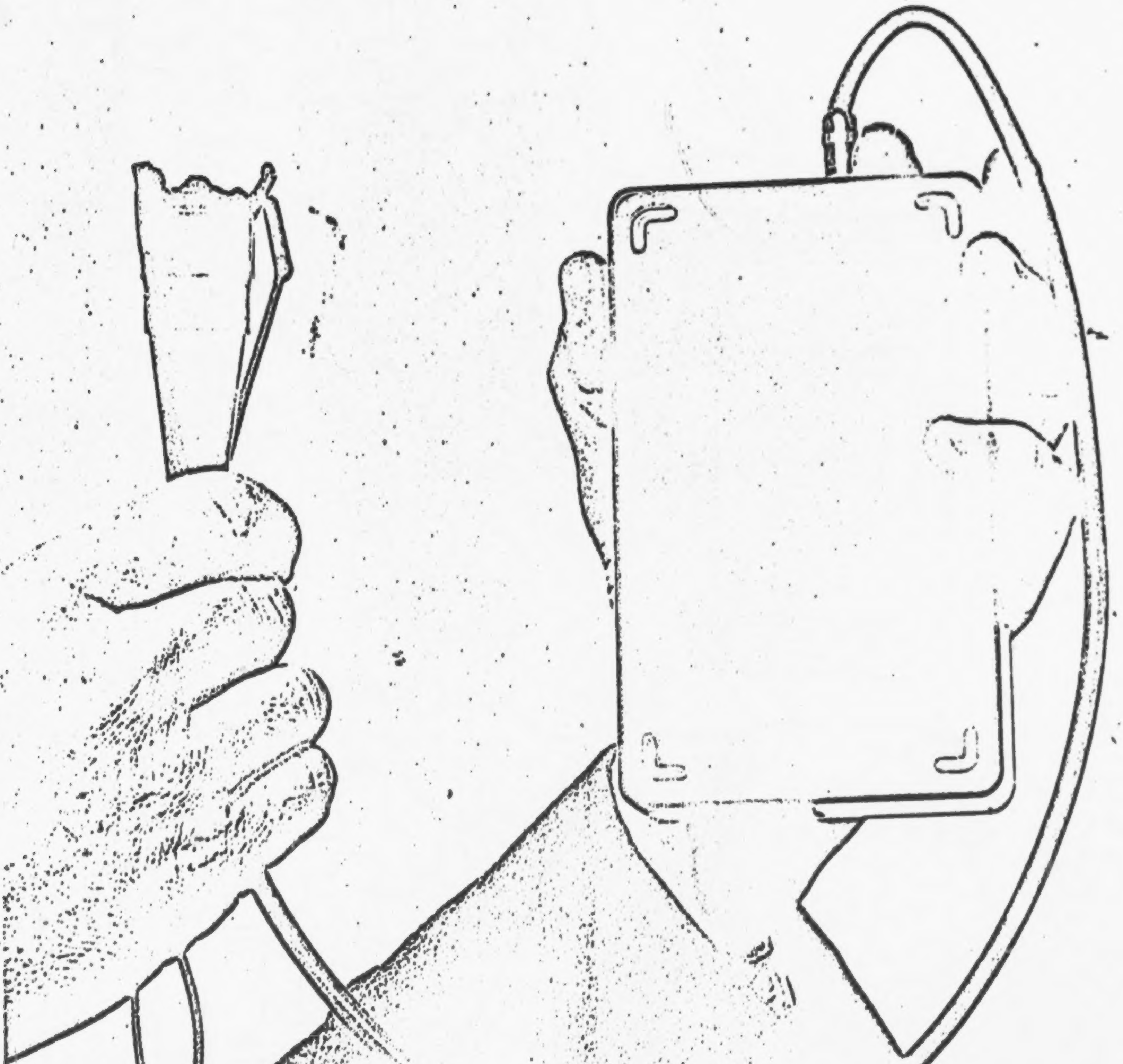


Figure 13.--Wireless Microphone Courtesy: Woodard Research Corp.

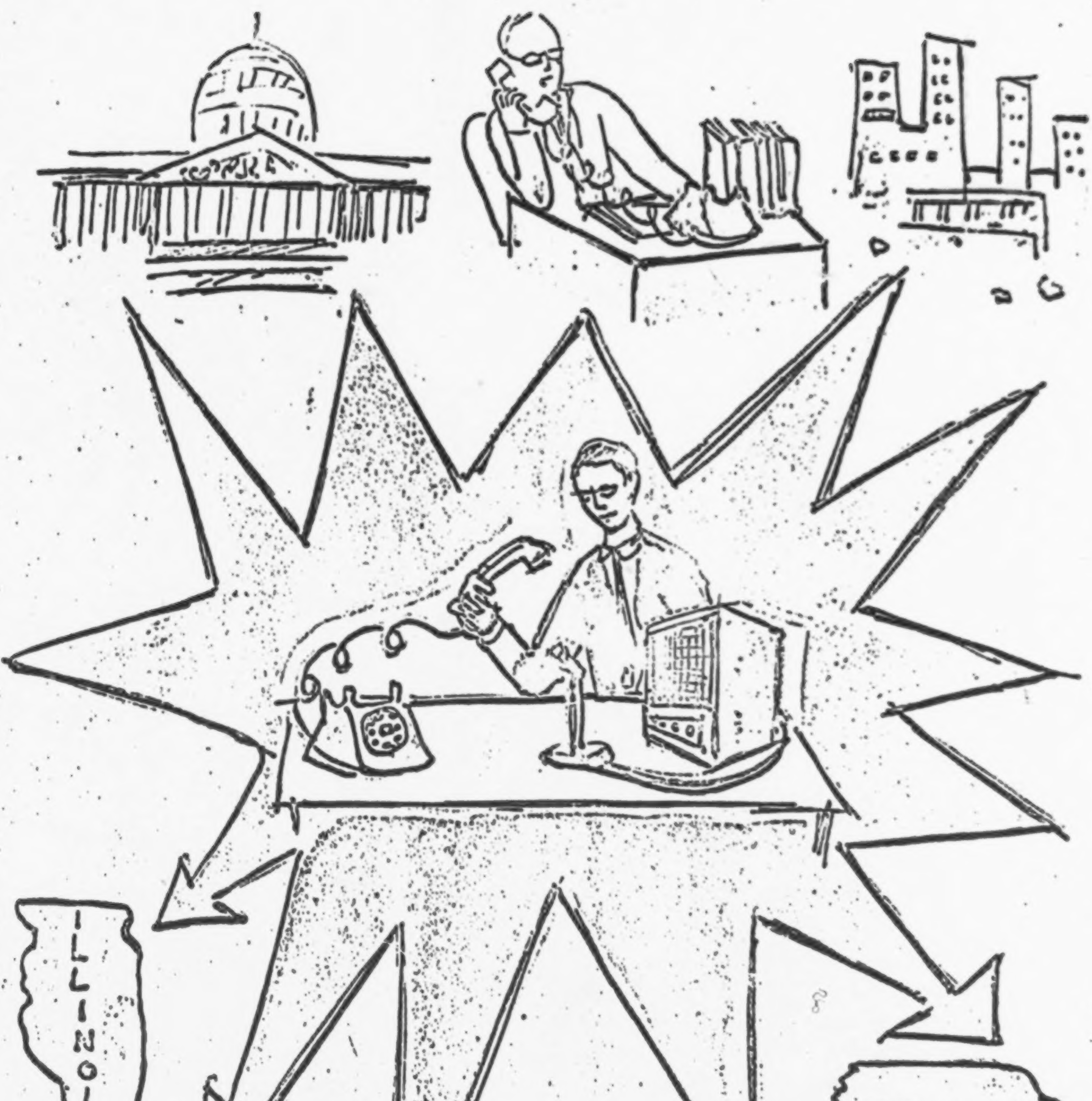
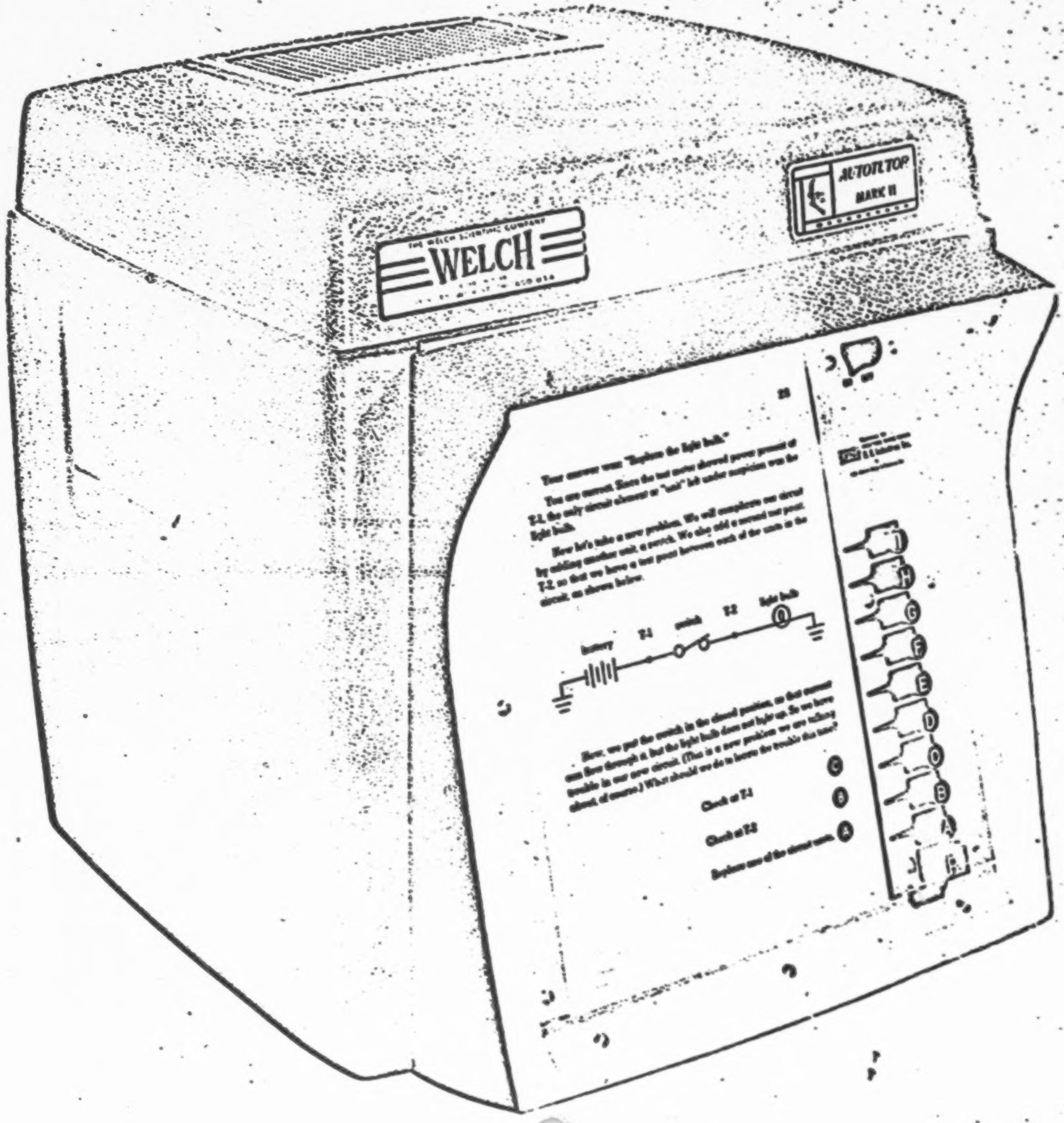

ILLINOIS
IOWA
NEBRASKA
KANSAS
TENNESSEE

Figure 14.--Amplified Telephone Network, Stephens College

Courtesy: Mrs. Dorothy Heibel


THE WELCH SCIENTIFIC COMPANY
WELCH
AUTOTUTOR
MARK II
25
battery
T-1
switch
T-2
light bulb
Check at T-1
Check at T-2
A
B
C
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H
I

Figure 15.--AutoTutor Mark II Teaching Machine Courtesy: Welch Scientific Co.

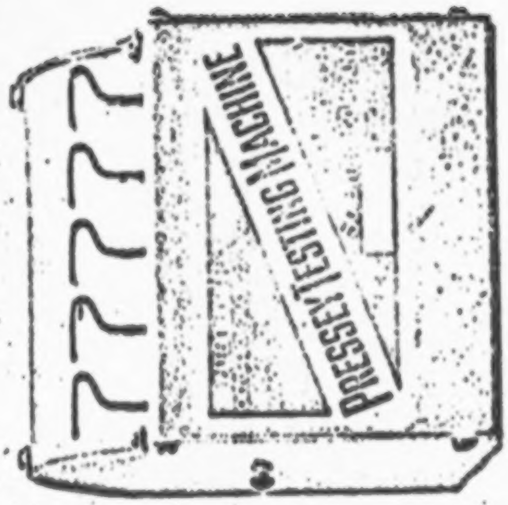
PRESSEY TESTING MACHINE

Figure 16.--First Teaching Machine Courtesy: Welch Scientific Co.

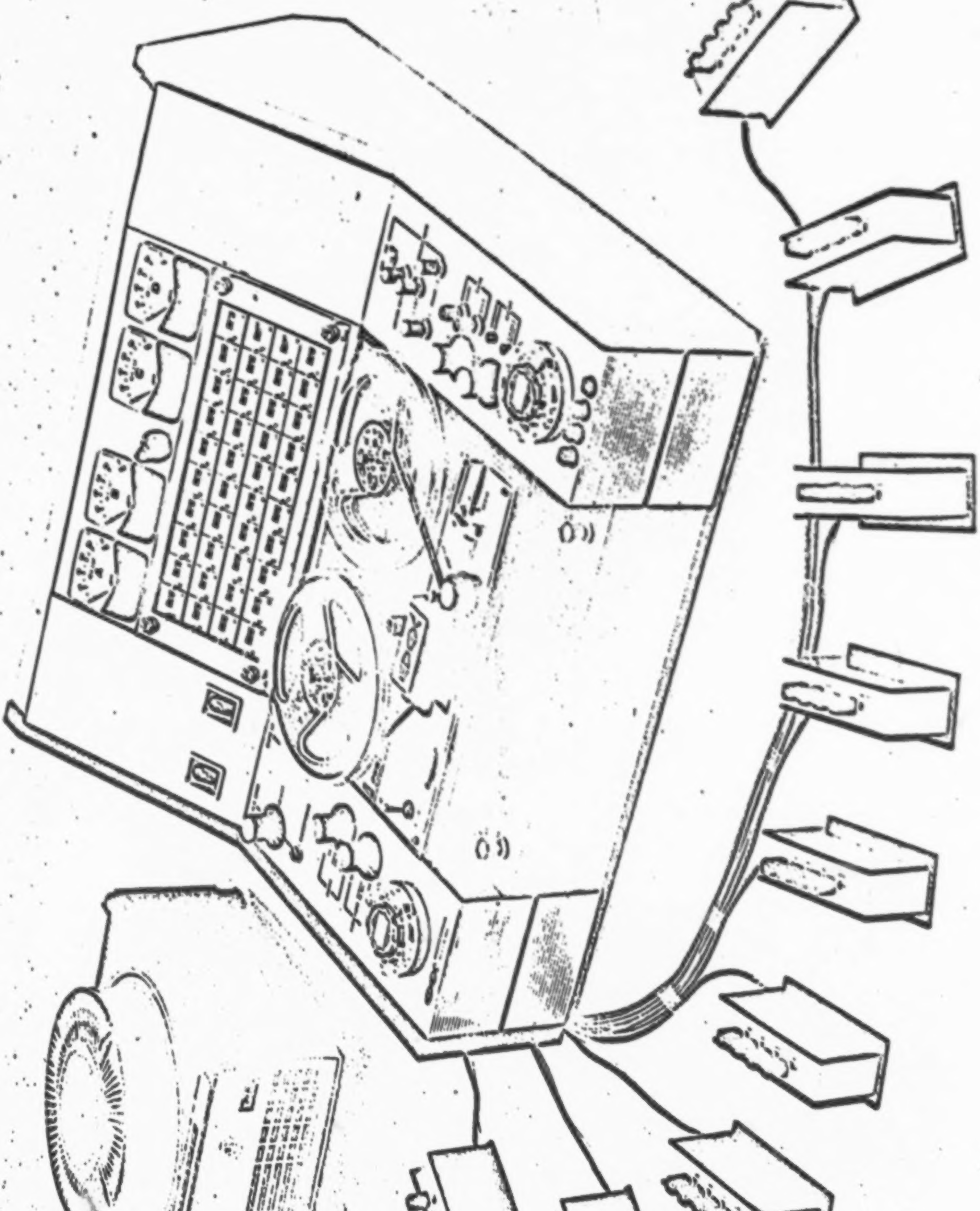

Figure 17.--Edex Response System Courtesy: Edex Corp.

CHAPTER III

SIMULATION AND GAMES

James A. Robinson
The Ohio State ~~[illegible]~~ University

Introduction

Simulations and games, in many forms and for many subjects, are among the most recent innovations in instructional techniques. Some are hardly "new media," however, because they are as simple and familiar as card ~~[illegible]~~ or board games. Others involve ~~rather~~ technical equipment for use in transmitting facts and principles about their subjects of study. This chapter begins with a definition of simulation and considers ways in which ~~how~~ simulations differ from conventional role-playing games. Then it ~~we shall~~ reviews the purposes and forms of games and simulations, principally in the social sciences. Following this description of current uses, it ~~we shall~~ summarizes evidence appraising ~~evaluating~~ the impact of these new techniques as educational devices. Finally, it ~~we~~ offers several recommendations for research and development.

What are simulation and games?

A simulation is a miniature representation of a large-scale system or process (Dawson, 1963, pp. 1-3; Brody, 1963, pp. 191-96). Laboratories provide arenas in which macro-processes are reduced in scale and complexity so that a teacher or student may manipulate the model of reality when he cannot manipulate reality itself. Biological, chemical, and physical laboratories are the original institutional forms for simulation. Test tunnels for ~~[illegible]~~ small-scale models of planes, weapons, and other machines ~~[illegible]~~ are newer ~~[illegible]~~ examples of simulation. Training installations on military and naval bases include simulated use of weapons in confined spaces, but with the appearances and context of the real situations to which they correspond.

Simulations are also "dynamic" or "operating" models, as opposed to static or pictorial representations. Simulation and games usually imply use of ~~the~~ replicas in phased sequences, and opportunities for change and development are generally present during all sequences.

This review of simulations is confined to social simulations; that is, representations of social processes, as distinguished from physical or biological ones. A few of the social processes for which simulations and games have been devised are politics, economics, education, opinion formation, decision making, and administration.

Although we shall use the terms simulation and games interchangeably, some writers ~~prefer to~~ distinguish them according to the ratio of manual to computer activity. Games usually designates activities that ~~which~~ are largely human; ~~while~~ simulation designates activities that ~~which~~ are highly computerized. We shall not insist upon this distinction.

We should note that games and simulation do not necessarily bear any relationship to game theory. The theory of games consists of mathematical assumptions about behavior under specified circumstances of conflict. Games and simulation refer to social processes that are not necessarily subject to the kinds of theorizing contained in game theory.

How does simulation differ from mock congresses and model U.N.'s?

Many high schools and colleges sponsor ~~use~~ mock political conventions, mock congresses, moot courts, and model U.N.'s to impart information about important political activities. The American Legion annually holds week-long meetings of Boys' State and Girls' State throughout the United States, followed by Boys' Nation and Girls' Nation in Washington. In all ~~of~~ these activities, students play out the central characteristics of different political institutions. Many of these activities can be conducted on a mass basis, with hundreds of people participating (some prominently, others peripherally), either during several days or weeks or ~~[illegible]~~ in a shorter period of time.

The simulations ~~to which~~ we shall mention differ from these role-playing events precisely in the extent to which role-playing occurs in them. Although some games or simulations involve a relatively high degree of role-playing, they have even less of it than the mass mock conventions or congresses. Simulations tend to formalize and program various aspects of the systems that they represent; that is to say, they permit less flexibility than do the free-wheeling mass conventions. Simulations concentrate more on the processes by which decisions are taken and devote less attention to the institutionalized and particular procedures of conventions or congresses. They require the participant to engage more in the dynamic interaction of the system and expect less of him in the way of second-guessing or of playing the role of a particular person or position.

Controversy abounds about the appropriateness of role-playing, but, in general, simulators distrust the student's or teacher's capacity to "dope out" the personality of a foreign leader, a state party chairman, or a similar figure (Greenlaw, Herron, and Rawdon, 1962, pp. 10-13). Instead, simulations emphasize the role as it interacts with other roles, and they require the participant to respond as he himself feels required to respond.

The de-emphasis of role-playing, the highlighting of process factors, and the formalizing of programs for the conduct of the simulation constitute the essential distinguishing characteristics of the new developments in simulation as compared with the more conventional mock programs. These characteristics reflect the growth of knowledge in the study of decision and political processes, as opposed to the use of knowledge of formal procedures of particular institutions. In these respects, the simulation and games to be discussed here differ considerably from mock congresses and model U.N.'s.

Classification of Games and Simulation

Purposes

Although the original impetus for games came from professions interested largely in practical application of knowledge and therefore in developing games for instruction, many games and simulations are essentially research instruments.[1] Indeed, with the exception of war and business games, most instructional simulations have grown out of games developed to investigate a particular system or process. Researchers usually have been ahead of teachers in developing these devices, and once the subject matter has been modeled in the form of a simulation, it has then been possible to teach the subject in a supposedly more challenging and more effective manner. Although this essay does not deal with simulations as research enterprises, it should be noted that in simulation activities a separate but equal policy segregating instruction and research may be unfortunate. Teachers will find it useful to be familiar with the latest models and simulations in their subjects in order to provide the best instruction possible for their students.

Instructional uses of games include both teaching and training

Teaching usually means the transmission of knowledge about subject matter through operational models. Training usually means the transmission of information or prerequisites for a particular role in professional or business life. In practice, simulation for teaching is likely to be found in the social sciences with a liberal arts or a general education orientation. Training activities are likely to be emphasized in professional and technical schools, where the objective is to prepare individuals for specialized tasks, such as business or educational administration.

The question is open whether simulations for teaching are appropriate for simulations for training. Indeed, with respect to the study of public affairs, one may wonder whether a simulation of a local government or of foreign policy making should be the same for supplementing a college course in political science and for an intensive short course for city managers or foreign service officers. Research has yet to discover whether training for policy making and training for citizenship are similar, or whether they differ sufficiently to require different educational programs.

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[1] For an introduction to a number of different simulations, see Guetzkow (1962). A useful directory of management games, including information about the basic models and administration, and where further information can be obtained, is Kibbee, Craft, and Nanus (1961, pp. 315-316).

Games for war, business, politics, and other subjects

War games are the earliest known effort to train practitioners through the use of operating models of their field tasks. In the late nineteenth century the Prussian general staff developed war games, and military organizations in other countries have since adopted them on varying scales (Gorlitz, 1956; Greenlaw, Herron, and Rawdon, 1962, pp. 7-8, n.15; Kahn, 1962, pp. 155-72).

Undoubtedly, the most influential and active diffusion of games has been in business education and training. There are probably as many business games as there are other forms of simulation put together. The one hundred business games developed since 1956 vary in their complexity and in the content that they teach. Games are available for training prospective businessmen in many aspects of commerce and administration, including marketing, production, inventorying, investment, personnel, and organizational decision making. Some business games are relatively simple operations that can be played largely with paper and pencil, in or out of the classroom, for short periods of time. Others are highly developed, large-scale, complex games that extend over a semester or a year and involve faculty members as well as students. The most sophisticated and best known of the complex games is the Carnegie Tech Management Game. It could hardly be said to be representative of business games, but it is doubtless the leading example at the present stage in the development of games (Dill, Jackson, and Sweeney, 1961, pp. 44-80).

The Carnegie Tech Management Game is the most complicated of the business simulations, and probably the most expensive. It consists of three teams of five to ten players, each team representing a detergent company. Teams make one hundred to three hundred decisions every "month" for future operations of their firms. Decisions cover raw material orders; additions to work force and overtime to expedite production, inventory, marketing, advertising, and consumer surveys. When the decisions have been made, they are entered in a computer that contains a model of the economy, industry, and company. The computer determines, according to this model, the outcomes of each company's decisions. Results are then reported, and teams begin a new period of decision making.

The game requires analytic or intellectual tasks, represented in the decisions that must be taken. Although the model for assessing the outcomes of the competing teams' decisions is deterministic, its complexity precludes devising an optimal strategy. In addition to requiring performance of analytic tasks, the game allows within each team for the roles that are differentiated enough to offer organizational tasks of some complexity. Interpersonal skills and relations, coordination, communication, and other organizational characteristics are important.

New business games frequently appear; often, they are reported in daily papers as well as in scholarly or technical journals. One implication of the increasing use and design of games is that, for one who knows the basic characteristics of his field, games are not necessarily difficult to design. In fact, it deserves to be stressed that teachers need not be frightened by games. Often the prospect of using computers, devising arithmetical formulae to state the parameters of a game, and other parts of the design seem forbidding and impossible to people whose experience has been primarily traditional classroom instruction. Nevertheless, games unquestionably vary in their simplicity, and the evidence from the business games indicates that one need not be inhibited from designing some games simply because one lacks highly complex equipment.

One of the subjects in which games have proliferated most quickly is politics. Most of the political games → used for teaching or training were originally designed for research. The influence of the RAND Corporation in developing games for playing out potential political and diplomatic strategies was responsible for the first games for teaching (Goldhamer and Speier, 1959). These games were followed by innovations at Massachusetts Institute of Technology (Bloomfield and Padelford, 1959), San Francisco State College (McClelland, 1959), and the University of Wisconsin (Cohen, 1962). Such exercises ordinarily deal with particular political problems in international diplomacy. For example, scenarios re- or pre-create situations comparable to some past or prospective international situations. Various games have played out the East-West conflict over Berlin, a revolt in a Latin American country, and similar "real world" events. The RAND, M.I.T., and Wisconsin games adopt real-world names for their countries and sometimes assign decision makers to represent particular international figures. These games also have umpires or referees to rule on the appropriateness or realism of strategies that players propose. The M.I.T. game has been played with students at other New England institutions, providing a league for diplomacy to correspond to leagues for athletics. These games can be played at a single point in time, as during a weekend, or over extended periods in the manner of chess-by-mail. The most frequent practice, however, has been that of playing the games on a college campus on a Friday afternoon, Friday evening, and Saturday morning, with time at the end of the game reserved for discussing its relation to the purposes of the course that it supplements.

A different simulation of international relations was designed by Harold Guetzkow and his associates at Northwestern (Guetzkow *et al*, 1963). Unlike the RAND and M.I.T. games, the Northwestern Inter-Nation Simulation does not identify its nations with real-world nations. Rather than calling a country Great Britain or Poland, the Inter-Nation Simuulation creates the fictitious names Algo, Ergo, Ingo, and so on. Further, titles for roles are decontaminated, and the aseptic title Central Decision Maker replaces that of prime minister or president; foreign ministers are referred to as External Decision Makers, and military officers are called Force Decision Makers. Real-world concepts such as GNP are replaced by Basic Capability, public opinion polls give way to an index of Validator Satisfaction, and concepts of democracy and government control are replaced by Decision Latitude.

The abstract character of the Inter-Nation Simulation is explained by its origins as a research instrument. Guetzkow and colleagues proposed to simulate what they regarded as central features of inter-nation processes without regard to cultural and historical contexts. In other words, in their initial efforts they tried to control for certain features that vary greatly in the international environment and to concentrate on other basic characteristics of international systems. Without denying the importance of the cultural heritage and historical precedents of a nation, they attempted to hold such factors constant during their simulations.

no extra #

Thus, when simulation was converted from research to instruction, it was already in a decontaminated form. The aseptic character of the Inter-Nation Simulation has several advantages over the rich, real-world quality of the RAND political exercises. For one thing, college students are simply not qualified to play Kosygin or Johnson. Although, when they are given such an assignment, they may read up on the person they are to play, still one runs the risk that they will "bootleg" as much inaccurate or irrelevant motivation as correct motivation into their performance of a world dignitary's role. Although playing an anonymous role may not encourage the student to extend his knowledge to the biographies of current leaders and their policies, it also may not lead him astray as he plays out the roles in the simulation. In fact, he will be challenged to play the role as he personally would play it, gaining some insight into his own performance and considering which model of diplomacy and negotiation he would like to adopt for himself.

Broadly speaking, all simulations are role-playing to one degree or another. One may play the role of politician as opposed to some other role. He may represent a decision maker from a real-world country such as Brazil or a fictitious one such as Omne. He may represent a particular figure or position. All simulations involve some acting out of roles, but we shall reserve role-playing to identify those games in which greatest emphasis is put upon close correspondence with the person who holds an identifiable office in a real-world state.

Compromises may be found between the extensive role-playing of the RAND and M.I.T. diplomatic games and the Guetzkow non-role-playing Inter-Nation Simulation. For example, Robert C. Wood, also of M.I.T., has designed a local politics game in which the names of cities and participants do not correspond to the real world, but in which the parameters and variables are conventional and identifiable in the real world (Wood, n.d.). The vote in Wood's simulation corresponds to the vote in the precinct, whereas in Guetzkow's game elections are represented by a conceptual formula has no operational counterpart in world politics.

In discussing business games, we said that they are manageable enough that independent investigators and teachers can design games for their own purposes. However time-consuming the design of the first political games, they are simple enough that they can be picked up readily and used by people who did not design them. For example, Guetzkow's Inter-Nation Simulation has been used by several of his Northwestern colleagues, none of whom was intimately connected with designing the game. Professors Henry Bretton and Harold Jacobson of the University of Michigan adapted the INS to their large international relations class after one day's visit to Northwestern, and they in turn were able to conduct a day's run of simulation for a seminar in national security policy at the Ohio State University. John Orbell and colleagues at the University of North Carolina organized an eight-hour run with the aid of published materials and without any outside assistance. Preparation, of course, requires careful study of documents, as well as trial runs, but the fundamentals of a particular simulation can be grasped without much prior exposure to the technique. Unfortunately, at this writing an adequate "how to do it" manual is not yet available for interested persons, so that diffusion depends principally on word of mouth and personal visits.

Probably the most vigorous and technically advanced work in developing simulations for teaching is in progress at the Johns Hopkins University, under the direction of the sociologist James S. Coleman. Coleman's first game, an election campaign game (Coleman and Waldorf, 1963), was designed for research and commercial uses, but it is now one of a series of teaching games that includes a career-choice game and a legislative game.

Coleman's model of high school behavior starts from the assumption that each boy and girl attempts to maximize his self-esteem (Coleman, 1962). Each student may be assumed to have his own level of self-esteem, and as he makes choices about time, friends, activities, and the like, he increases or decreases his estimate of self. In the game of high school, each player takes the role of a high-school student. Parents and teachers are represented through the calculations prepared by those who designed the game. Players make both long-term and daily choices of activities, and a choice of persons' judgments to pay attention to. As these decisions are taken over an extended period of time, the consequences gradually unfold. Results are reported to the players, and they may use the knowledge of previous outcomes in making future decisions.

The purpose of this game is well summarized by Coleman, and, indeed, it is the central purpose of most educational simulations: "It allows a boy or girl to act through situations before he faces them in real life, to see the indirect and long-range consequences of choices he may make, before it is too late, and he must face the consequences in real life" (Coleman, 1962, p. 4).

The International Business Machines Corporation several years ago began to consider the implications of new simulated learning environments for investment. Its interest was not in programmed learning through teaching machines but in computer and other technological developments that might simulate learning environments on an individually paced basis. In the Summer of 1962, IBM awarded ten summer fellowships to outstanding teachers in the Yorktown Heights school system (more than one hundred applied) and organized a seminar in which each teacher began to design a simulation for his specialty. Subjects on which work was done included the development of Sumerian civilization, qualitative analysis in the study of light in an elementary science course, principles of art discrimination, instrumental music, and French through a simulated United Nations environment. Progress in developing simulations for each of these courses has been uneven, but by the end of 1964 the Sumerian game was ready for experimental use and could be played from a typewriter terminal hooked to a 7090 computer. The qualitative analysis simulation was also made ready in late 1964, and its materials were tested at a California teachers' college.

Impact

The popularity and increasing use of games and simulation are apparent from the record since 1956, when the first business game was designed. What is less evident is whether games serve the purposes attributed to them, whether they do so more or less effectively than alternative modes of instruction, and whether they have any unanticipated consequences. Questions of this sort call for "quasi-experimental" research that varies and controls for hypothetically important characteristics of games (Campbell, 1957; Campbell and Stanley, 1963). Designs for such research are often difficult to formulate and more difficult to execute in practice. Moreover, so many different games exist that it is impossible to evaluate and compare anything except the central features of a few simulations.

Should games be evaluated?

In many quarters, even among professors of education, low priority is given to the systematic and controlled evaluation and comparison of teaching techniques and supplementary aids. For some the disinclination to study teaching methods is part of the popular anti-educationist syndrome. Jacques Barzun (1963), in justifiably praising William James's Talks to Teachers, goes so far as to assert that that book "...still contains nearly all that anyone need know of educational 'method.'" For others, the lack of enthusiasm for comparative studies of methods stems from the plethora of negative results and "no differences" found in early experiments. Indeed, experimental devices that occupy only a marginal part of a student's time may scarcely be expected to have much observable or unusual impact upon his learning.

Part of the reluctance also comes physical and natural from scientists who retreat from extending scientific methods to the study of human affairs, and from social scientists who hesitate to study their own teaching with the same rigor they apply to industry, government, and other objects of social investigation. Martin Mayer (1963, p. 168) summarizes the philosophy of the physicists, all distinguished researchers, who revolutionized the teaching of secondary and college physics.

> At no time did the scientists place any great weight on "scientific measurements" of what they were accomplishing. They did work with the Educational Testing Service to design a test to assure that PSSC students would not be penalized in the bureaucratic world of admissions and to guarantee themselves against gross over-optimism about what they were accomplishing. But impressionistic, intuitional feedback from those who were teaching and learning the material weighed much more heavily than test results when the committee sat down to analyze how it was doing. The committee is still analyzing and revising on the basis of judgment.

Impressions, intuition, and judgment are unquestionably sources for discovering ideas in education, as in physics; but as they would not be relied on for demonstrable verification of the movement of electrons, why should they be overweighted in verifying the advantages of one curriculum or teaching device over another?

This hesitation to evaluate is not confined to physical scientists; one finds it among hardheaded economists, operations researchers, and other social scientists who profess science. I recall observing this at the first teaching conference I attended several years ago. One of the large foundations had invested considerable money in encouraging business schools to design and use games in their curricula. Unfortunately, perhaps, no evaluation was built into the budget for this large program in gaming, but the foundation did have the good judgment to call together some of the people who had used games to pool their personal experience. Because of my interest in political games and in their evaluation, I was invited as the one outsider. I am afraid I made myself → more of an outsider by offering ← homilies about the importance of knowing what we are doing and asking what evidence is available for the claims for games, evidence of the quality we would expect in our own technical work, whether economics, business, or political science. The number of evaluations has not increased, apparently; yet such research on instruction seems to me the soundest way to understand what we are actually doing, to avoid fads, and to give students the fairest and best available mode of instruction that reliable knowledge affords.[2]

Games at the secondary and elementary levels

Simulation of the simple games variety promises to be particularly appropriate for elementary and early secondary education in civics. Pre-college instruction in government, citizenship, and public affairs is notoriously unsophisticated. The discrepancy between scholarly descriptions of political processes, on the one hand, and the public school teacher's description of the checks and balance system, on the other, is likely to be greater than that between reliable scientific knowledge of family matters, courtship, and marriage, and the increasingly frank treatment of these subjects in schools. Gradually, realistic discussions of rectitude have lost their taboos, but politics usually remains outside the domain of the schools.

While teachers and administrators gingerly ignore the topic, boys and girls nevertheless acquire perceptions of politics, and attitudes and values about government. Recent research on political socialization documents that preadolescence is usually the critical period for the development of political interests and orientations (Hyman, 1959, ch. 2-4; Easton and Hess, 1961, 1962; Wahlke et al., 1962; Greenstein, 1965). If this finding is borne out in the next stages of research, we shall have ——> cause to wonder whether student senate campaigns, college internships, and mock congresses can do more than confirm the already politically inclined in whatever values they have previously acquired. If education in politics is to reach more than a select group, it will have to begin earlier and/or take a form that will reach many more youngsters than can be affected by campaigns, internships, and mock conventions.

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[2] An additional obstacle to evaluation of business games by economists or diplomatic games by political scientists is the specialists' natural unfamiliarity with the extensive educational psychological literature, such as that on "the criterion problem." When university faculties combine a center, school, or an institute that emphasizes research on teaching with experimentally inclined social science departments, the setting is likely to be more conducive to appraisal of teaching activities.

At Johns Hopkins, James S. Coleman and Sarane S. Boocock have evaluated the use of their election simulation in four Baltimore high schools. In two schools the game was played during a two-week period, and in a pair of similar schools the game was not used at all. Student interest and performance at the four sites were compared.

Although there was little evidence that the presence or absence of the game affected students' learning of factual material, considerable data supported the impressions of teachers and investigators that students liked the game and that it increased their interest and involvement in Course work. The researchers' explanation for the absence of a relationship between use of simulation and learning about social studies is that the game was not intimately related to course materials. Nevertheless, little doubt exists, as indicated both in questionnaires filled out by students themselves and by observations taken by the researchers, that student motivations were affected by the game. Moreover, attitudes toward politics also seem to have been affected, with realistic and critical attitudes increasing among the students participating in the game (Boocock, 1963).

Secondary schools may well be the most appropriate settings for simulations about politics and public affairs. Assuming that adolescence is a critical stage in the acquisition of political orientations, this may be the point at which students ought to be challenged to think through critically their choices of party affiliation, values, and the like. To the extent that th motivate students and penetrate their developing but unconscious "set" toward politics, games may be effective instruments for acquiring self-insight.

A comparison of simulation and case studies in college

In 1959, Chadwick F. Alger began using Inter-Nation Simulation in undergraduate international relations and international organization classes at Northwestern. He solicited student comments and criticisms and reviewed various uses of other games and simulations as supplementary teaching devices. On the basis of this initial exploration, which extended over parts of nearly two years, it was possible to formulate a series of hypotheses about the effects of simulation in the classroom (Alger, 1963; Robinson, 1961). To strengthen the devil's advocacy, we considered a strong challenge to simulation—the much tried but never evaluated case-study method, for nearly a century a staple of the law schools, and more recently a popular adjunct to curricula in business and public administration, legislative politics, decision making, and other subjects. In planning a quasi-experimental comparison of simulation and cases, we knew that our evaluation of one form of simulation, even if done in several courses with different teachers, could not necessarily represent all simulations. Accordingly, we were hopeful of studying hypothetical effects that had been commented upon by users of other games.

The six hypothetical effects that we investigated are among nine mentioned during the Tulane University Conference on Business Games (Dill, Jackson, and Sweeney, 1961) and eleven listed in a review by Cohen and Rhenman (1961). Five of our six alleged effects fall within the Tulane list and the Cohen and Rhenman list, while seven from the Tulane list and ten from the Cohen and Rhenman list can be translated to ours. This led us to think we were studying some central hypotheses and that our comparison of Inter-Nation Simulation and political case studies might be relevant to the evaluation of other games.

Below we will review six hypothetical effects of simulation and then report preliminary efforts to see whether they are in fact produced by simulation and in any way different from those produced by the case method.

Interest.--The major claim for gaming or simulation is that the method heightens student interest, thus enhancing learning. C. P. Snow (1960, p. 23) recommends putting the student in the position of the original discoverer as a way of exciting him about science and enticing him to creative work. So far, most of the observations of motivation in simulations have been anecdotal, but the testimony of several directors of simulations is that motivation is strikingly increased by simulation. However, the reports are not uniform. At Carnegie Tech, where the business game extends throughout a semester and is the equivalent of one of five graduate courses, the game is disliked by some students. At the University of Wisconsin boredom and absenteeism were observed among students who occupied relatively unimportant roles in a political game (Cohen, 1962).

By interest we mean the student's involvement in the course. We assume that students who are highly interested will attend class more regularly, buy more reading materials and read more of them, participate in more peripheral activities such as lectures, and undertake more volunteer work than students who are not highly interested. When these assumptions about interest or involvement are clearly stated, a number of "non-reactive" instruments come to mind, for measuring interest. Use of closed reserve materials in the library, attendance at non-required discussions or lectures, book purchases at local stores, student comparison of time spent on a course using simulation with courses not using it--all these are among possible devices for measuring interest. In addition, each course is likely to have a graduate teaching assistant who can act as informant, and teachers may find it useful to keep notes identifying the students who ask questions, stay after class, come to their offices, and exhibit other signs of interest.

Initially, we thought of interest only as an intervening variable, one of the mechanisms that produce learning of principles and facts. Even if we are not in the business of interesting students for interest's sake, however, it may be that different techniques differentially affect substantive interests, and therefore subsequent reading, and perhaps even career plans. This is what is meant when evaluators say that the effects may be long term. We tried in one experiment to follow up on two groups six weeks after their course ended. and to give them tests for retention, as distinguished from tests of recall. However, the costs of seeking out the students, given all our other experimental commitments, led us to drop this important feature.

Feedback.--One of the most influential current theories of learning holds that reward for successful or approved action reinforces one in a way that encourages similar performance in subsequent situations. Simulation provides results of participants' decisions shortly after they are made, thus giving the student feedback, or evidence, of the quality of his decisions. This validating or non-validating mechanism is not ordinarily present in case studies, problem papers, class discussions, and other conventional learning methods, and it appears to have some of the effects of teaching machines.

Time is greatly compressed in games and simulation. Decisions are made hourly that represent → real-world decisions of a month's or a year's duration. For example, in → Inter-Nation Simulation, budgets are prepared usually every sixty minutes, so that the fiscal year corresponds to an hour. Results are reported within half an hour for use in making decisions in the next decision period. This feedback gives the student, or simulator, evidence of the appropriateness of his decisions. If the assumptions about "learning by doing," "learning through participation," and the like are right, students who experience simulation feedback ought to learn differently (at faster rates—and perhaps they ought to learn different things.

Explicitness.--Freudian psychology and psychoanalysis → emphasize the value of rendering the implicit explicit. Individuals cope with their personal problems more adequately when they understand clearly the sources of the problems. Businessmen, teachers, and doctors supposedly improve their performances through others' reports on their work and through detailed discussions of their procedures, many not always noticed by themselves. Self-observation is → a technique through which one may "escape to freedom" from practices one unconsciously pursues but would not consciously prefer → (Lasswell, 1963, pp. 224, 125-42). Beginning scholars are advised to acquaint themselves with the choices available to them for approaching and treating their subjects; "the assumption is that these choices are likely to be wiser if they are made deliberately and self-consciously..." (Van Dyke, 1960, pp. vii-viii). In short, the hypothesis is that explicitness or awareness about one's position, role, problem, job, or situation improves one's performance.

Simulation and games allegedly make participants more explicit about what they are doing, seeing, or hearing. Students are then led to interpret their activities in terms of "principles" and "concepts" discussed in other course materials. Explicitness may be defined as the capacity to identify consciously elements of a problem in an analytic or technical sense. This skill is more than "knowing" the existence of an abstract quality or object, and more also than being able to define a term or a concept. It is not merely having a "feel" for a situation in the sense of experiencing insight through a sudden surprise or a "eureka" experience. It is the conscious recognition that a particular experience belongs to a certain class of phenomena; it is recognizing the analogy between event A and class M. It is the skill to identify an object in a context and to be able to give it a technical label, which then throws the object open to interpretation in terms of the principles associated with the technical concept.

For example, Herbert Simon reports that "satisficing" is characteristic of alternative selection in problem solving and decision making. To "satisfice" is to adopt the first solution or alternative that seems "good enough" to solve one's problem or decision; it is less "rational" than the optimal decision postulated by classical theories of economic and administrative decision making, but it is also more typical and more descriptive of human activity. Lectures or case materials may identify and stress this fact of decision making, and students may be able to define the term, match it with its definition in a list of definitions, or regurgitate it in an essay examination. Beyond this, however, one object of teaching is to help the student discover such behavior in its rich, manifold context.

The effects of simulation on students' interest, feedback, and explicitness may be regarded as intervening procedural mechanisms, which in turn have impact on the content of learning. The ultimate impact of simulation and other methods will be reflected in students' command of the principles of whatever subject they are studying and of the discrete factual information relevant to their inquiry.

Principles.--Learning of principles is general and structural; it is not confined to specialized content and issues. Such learning creates in the student's mind an abstract "model" of international politics, foreign policy processes, or whatever the field may be, without regard to specific policy issues such as aid to underdeveloped areas, the use of nuclear weapons, or the role of the Federal Communications Commission in regulating television.

Facts.--Factual learning refers to discrete bits of information, historical as well as contemporary. Lasswell (1960, p. 216) has remarked that in classroom simulation, "Motivations to study past events are kept high since the uses of history are demonstrated by the search for suggestive likenesses or differences."

Empathy.--Still another kind of learning concerns neither principles nor facts, but rather an appreciation of, or empathy for, the predicaments of the real-world decision makers. One form of empathy this experience usually results in is an increased capacity to take the participant's perspective in analyzing or evaluating a decision or event. This is not to say that the student abandons a critic's viewpoint but only that he incorporates an additional datum, namely the participant's perspective, into his analysis.

Students who participated in the simulation called this effect to our attention. Frequently, they reported that, after representing a small country, they "understood" how small nations' representatives see the world, or that, after experiencing a communications breakdown in an overloaded information system, they could comprehend that organizational factors, not merely "original sin," can explain unwanted decisional outcomes.

Important as we think this effect is, and confident as we are that some such mechanism is at work, our efforts to operationalize empathy repeatedly were unpromising. Finally, lest other aspects of the research be compromised, this variable was put aside.

Experimental procedures

To evaluate ⤳ claims for simulation, we chose three upperclass courses at Northwestern in 1963-64. The first, American Foreign Policy, had fifty-seven students, all of whom attended two lectures weekly, thirty of whom were in a three-hour simulation section, and twenty-seven of whom were in a two-hour discussion of case studies. Subsequently, courses in international relations (N=47) and administrative decision making (N=30) were similarly subdivided.

The experimental procedure was the same throughout all courses. All students met together for two one-hour lectures each week; then one-half attended a simulation section and the other half attended a case section. The simulation group met one afternoon weekly for three hours to participate in a simulated decision situation and to discuss the relevance of the simulation to the course; the case section met on another afternoon for approximately the same length of time to discuss cases and to relate them to other course materials. The assignments of students to sections were made during the first week of the courses on the basis of intelligence (as measured by scores on the Scholastic Aptitude Test), grade-point average, and other personality characteristics on which data were collected at an early class meeting (i.e., motivations toward achievement, affiliation, power, and cognitive style).

Personal motivations toward or needs for achievement (n ach), affiliation (n aff), and power (n power) were measured by an adaptation of the Thematic Apperception Test developed by McClelland et al. (1953) and Atkinson (1958). Students were designated as high or low in need for achievement, high or low in need for affiliation, and high or low in need for power according to whether their scores fell above or below the class median.[3]

Cognitive style refers to levels of abstractness-concreteness in cognitive structure. Harvey, Hunt, and Schroder (1961) suggest that this level varies according to the "stimulus boundness of the individual." The more concrete the person's cognitive style, the more bound to the stimulus he is—i.e., the stimulus tends to dictate his response. The more abstract one's cognitive style, i.e., the less bound to the stimulus he is, the greater will be his ability to abstract relations from experience and organize them according to their interrelatedness. Cognitive style was measured by the Situational Interpretation Test, which ranks individuals by quartiles along a continuum from the most concrete to the most abstract. We will refer to the four groups as concrete, moderately concrete, moderately complex, and complex.

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[3] Scores on TAT are determined by content analysis of short essays written in response to the projection on a screen of several penciled sketches. Content was analyzed for each of the three courses by the same two scorers. The rank order correlations between their scores on a sample of essays were as follows: Males: n ach., .83; n aff., .83; n power, .66. Females: n ach., .84; n aff., .73; n power, .66.

The personality variables listed above were selected for several reasons. First, student motivations toward achievement and affiliation have been found to interact with teaching methods and practices in other educational experiments. If our research were to contribute to the continuing development of educational psychology, this decision seemed imperative. Second, these same motivations, together with motivations toward power, have a history of interest to political analysts, and, insofar as was possible, we hoped to fit our teaching experiment to some of the continuing concerns of political theory. McClelland's (1961) study of the relation of _n ach_, _n aff_, and _n power_ to economic growth is perhaps the most impressive demonstration of the relevance of these personality variables to politics. The theory and research inspired by Lasswell (1930, 1934, 1948; Rogow and Lasswell, 1963) on the relation of power and personality to politics constitutes another interest of political analysts, to which we hoped our work might not be unrelated. Third, Driver (1962) has studied the influence of variations in concreteness-abstractness of cognitive style on decision making in an earlier use of the Inter-Nation Simulation. If relations could be found between cognitive style and decision behavior in simulation, it seemed reasonable to investigate hypothetical relations between cognitive style and learning in simulation.

Findings on interest and learning

We undertook to develop and use several measures of interest, assuming that interest is probably multidimensional and that findings supported by several measures deserve greater credibility than findings supported by single indicators. In all, we had ten measures of interest, including the students' reports of the amount of reading they did on the subject matter of the course, their comparison of their interest in the course with interest in others taken simultaneously, their perception of interest in political science, their preference for case or simulation, their attendance in class, their visits to the professor's office, their use of special reading materials placed in the reserve room of the college library, their descriptive evaluation of the course at the end of term, and their rate of participation in lab section.

Data on these ten indicators of interest were available for twenty-three "subsets" among the participants in the three experimental courses. These subsets consist of all the students enrolled; all males; all females; ← males and females separately grouped according to high and low achievement, high and low affiliation, and high and low power; and males and females separately grouped in terms of their cognitive style (concrete, moderately concrete, moderately complex, and complex).

When one lists the findings, as in Table 1, they seem to have no pattern. Certainly, neither simulation nor case is clearly more effective than the other in stimulating interest. And most certainly, the results do not fit the predictions, → namely, that simulation would be uniformly superior to case in exciting student interest and involvement. Nevertheless, an unexpected pattern emerges.

case → is more successful than simulation in eliciting student interest as measured by students' perceptions; but measures of student behavior indicate that simulation is more successful than case in affecting student interest and involvement.

Perceptions of interest

Our way of eliciting perceptions of interest was to ask students a number of questions on a Course Evaluation questionnaire at the end of term. This was administered at the last regular meeting of the course; the cover sheet instructed students to elect one of their number to collect the questionnaires and deliver them to the office of the secretary of the department of political science, where they would be held until the instructor filed his grades for the course. This procedure was adopted to assure students that their evaluations of the course would not influence their grades. As far as we could tell, students did not doubt the integrity of this procedure, and in each course they cooperated by responsibly handling the delivery of the questionnaires.

As Table 1 (columns A - E) indicates, four of the five perceptual measures of interest did not discriminate between simulation and case sections. We found virtually no differences between the two in students' perception of the amount of reading they did for the course, or in their interest in the course relative to other courses, or in their estimates of the degree to which interest in the subject had been stimulated by the course, or how much their interest in political science had been stimulated by the course.

Perception of interest in lab section.--The one discriminating perceptual measure of interest was a question asking the student to indicate, regardless of the lab section in which he participated, his preference between simulation and case. The Course Evaluation form asked:

> 15. Had you been able to choose the type of lab session to attend at the beginning of this quarter, which would you have preferred? Case Study Lab ____; Simulation Lab ____. Would your preference be different now? Yes____; No____.

We computed, for each group, the per cent who preferred case and the per cent who preferred simulation. The per cent who preferred the section other than the one to which they had been assigned was subtracted from the per cent who preferred the section in which they actually participated. This yielded a measure of perceived interest in or preference for one section over the other; those who voted for the section opposite theirs presumably showed less interest than those who voted for the section in which they had been members. The data for all students are displayed in Table 2. Only two groups, the males with greatest and moderate cognitive concreteness, preferred simulation to cases. The range of percentage differences in favor of the case was from 1 per cent to 75 per cent. No test of significance was applied to these data, but the interpretation is clearly that students perceive the case as preferable to simulation.

Behaviors of interest

To the extent that students' perceptions of these two supplementary teaching methods vary, they favor the case. It is striking, however, that observational data of actual course behavior, i.e., participation, indicates just the reverse—that more interest is displayed by students in simulation than in cases. Three of the five behavioral measures revealed important differences between the two sections.

Behavioral interest expressed through attendance.--The instructors did not keep attendance at lectures, but observers who were present at each section meeting noted who attended, who remained after the formal close of the section meeting, who was tardy, and who left before the official termination hour.[4] Each individual was given an attendance score consisting of the number of times he attended his section, plus the times he remained afterward, minus the times he was tardy or left before termination.

This objective measure of interest revealed that in twelve of the twenty-three subsets the simulation section displayed more interest than the case section. This was true for the aggregate of all students, for all males, for all females, and for males with low n ach, males with high n aff, males with high n power, males with low n power, males with the most complex cognitive style, females with high n ach, females with low n aff, females with low n power, and females with most concrete cognitive style. Tables 3-a, 3-b, and 3-c report data for all students, all males, and all females.

Behavioral interest expressed through Course Evaluation essay.--At the end of the Course Evaluation form, students were asked an open-end question to which they could respond with any additional comments about the course and the section in which they participated. In contrast to the perception of interest questions, there was no element of forced choice about this item; indeed, students were invited rather than instructed to answer. Thus, whether they commented, and the direction of their comment, is a manifestation more of behavior than of perception. The question read:

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[4] The presence of the observers was explained to the sections at the first meeting and justified in terms of our desire to contribute to better undergraduate teaching on the basis of empirical research.

> 20. If you feel there are things about American Foreign Policy [or International Relations, or Administrative Process] which you had thought you'd like to get out of this course and didn't, would you please list them in the following space.
>
> 21. The rest of this page is for any additional comments which you would care to make.

These responses were analyzed for the presence of positive comment, negative comment, or a mixture of the two. For sixteen of the subsets, students in simulation made more positive comments than students in cases, but in four of the subsets the case section students offered more positive comments. The data for all subsets are not subject to tests of significance because of the reduced number for analysis, owing to the fact that students could abstain from commenting if they so desired. We have reported the direction of their comments, either positive or negative, although for all students writing either strictly positive or strictly negative comments (N = 64), the differences are not significant, as Table 4-a shows.

Behavioral interest expressed by rate of participation in lab section.--Rate of participation was computed by counting the number of communications of each student in the lab sections and dividing by the number of lab sections he attended. The number of participations per section attended was overwhelmingly greater for simulation than for case. In fact, the differences between the means for simulation and case for twenty-two of the twenty-three subsets were statistically significant; only males with moderately complex cognitive style did not have significantly higher rates of participation than the corresponding males in the case section.

In one sense, this finding is not surprising, because simulation sections include national conferences, bilateral and multilateral conferences, and other small group sessions in which the opportunities for student participation might be expected to be more numerous than in traditional discussion sections. It is not trivial, however, because the promotion of activity may be one of the key ways of motivating students.

Summary

The major conclusions from the behavioral measures of interest are (1) that they are ~~generally~~ more effective than the perceptual measures in discriminating between simulation and case sections; (2) that three of the measures--attendance, course evaluation essay, and rate of participation--indicate greater interest among simulation sections; and (3) that these behavioral measures differ from the one perceptual measure in the direction of student interest.

Learning Outcomes

The most fundamental reason for studying teaching methods is to determine what methods under what conditions favorably affect student learning. If different methods do not have different effects, one can leave to taste and cost the selection of one method rather than another. If, however, for some kinds of students, one method is more effective for learning than another, the presumption rests with that method, assuming that cost and other factors are equal.

We undertook to measure student performance for two kinds of learning, mastery of factual materials and understanding of principles. For each course, we administered equivalent tests for fact-mastery and principles at the beginning of the quarter and again at the end. The pre-test-post-test design allowed us to analyze covariance to determine whether teaching method is related to changes in learning during the course rather than relying only on difference in performance on the final exams.[5]

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[5] Details on the tests and their reliabilities may be found in Anderson, M. Hermann, Robinson, and Snyder (1964).

We predicted better performance on both fact-mastery and principles by simulation sections, and we expected that any exceptions to this generalization would relate to particular personality subsets. An analysis of covariance, however, revealed no statistically significant differences between simulation and case for any of the twenty-three subsets with respect to fact-mastery. The same was true of all sets on the objective part of the principles examination. That is, no statistically significant difference in pre- and post-test performance was evidenced for any of the sets. Virtually the same finding held for performance on the essay part of the examination; only one set, males with low n aff, fared significantly better in simulation than in case on the principles essay.

In short, simulation and case hardly differ in their relation to performance of these two learning outcomes, fact-mastery and understanding of principles. If simulation and case differ at all, assuming internal validity of our procedures, the differences are complex and indirect. No simple and direct associations between method and learning were found. Let us now consider interest as an intervening variable, which when controlled for, might mediate the indirect influence of simulation or cases.

Interest and learning outcomes

To see whether interest intervenes between method and learning, we shall consider the four interest measures that discriminated between simulation and case (see Table 1, columns E, H, I, and J). These are the perceptual measures of lab preference and the behavioral measures of attendance, course evaluation, and rate of participation.

Table 5-a displays the mean improvement on the two learning variables for males and females according to whether they preferred their own section or the opposite one. In all but one set, those who preferred the other lab section scored better on fact-mastery, i.e., showed more mean improvement between the pre- and post-course scores, than did those who preferred their own lab. (The one exception was females in case section, and for this set, those girls scored higher who preferred their own lab;

however, the number of those who preferred simulation was quite small [three].) The differences in mean improvements were not great between those who disliked and those who liked their own labs, except for females in simulation. In that group, the eleven who preferred case had a mean of 18.9091 compared to a mean of 4.8462 for the thirteen who preferred to stay in simulation.

In addition to revealing a ~~general~~ difference between students who preferred their own lab and those who preferred the other, Table 5-a also indicates a difference between students preferring case and students preferring simulation regardless of the section they were actually in. Taking each of the four subsets (i.e., males in simulation, females in simulation, males in case, and females in case), we observe that in three of the four sets the mean pre-post-test improvement was greater for students who preferred case.

When we examine the relation of lab preference to principles-learning, we see the same kind of relation noted between lab preference and fact-mastery. That is, except for one subset, males in simulation, those who preferred the other lab did better, i.e., showed more mean improvement between the pre- and post-course examinations.

(¶) The relation between object of preference and learning of principles, however, is exactly opposite that between object of preference and fact-mastery. In three of four subsets, students who preferred simulation did better.

Now we take up the behavioral measure of interest as expressed by attendance and its relation to fact-mastery and principles-learning. Table 5-b reports the correlations between rate of attendance for males and females in case and simulation and fact-mastery and principles learning. Although none of the correlations is large, two points stand out. First, for three of the subsets the correlation between attendance and fact-mastery is negative, but all the correlations between attendance and principles learning are positive. Second, the high positive correlations between attendance and learning are for males in simulation and females in simulation.

We come now to the behavioral measure, course evaluation essay, and here we have findings reminiscent of those on the perceptual measure of lab preference, in which those who preferred the opposite lab did better than those who preferred their own. Table 5-c displays mean improvement scores for both males and females by section, and according to whether they positively or negatively evaluated the course. In all subsets, negative evaluators have higher mean improvement on fact-mastery than positive evaluators, although this is significant only for simulation males. Likewise in all subsets, negative evaluators show a higher mean improvement on principles than positive evaluators show, but none of these differences is significant.

Next we consider rate of participation as an interest measure intervening between method and learning. Table 5-d reports correlations between rate of participation for males and females in case and simulation and fact-mastery and principles. Notable in these data are the relatively low correlations, with only two of the eight higher than 0.3. Moreover, five of the eight are negative correlations, and simulation males are the only subset with positive correlations between rate of participation and both fact-mastery and principles.

Summary

The relations between simulation and learning outcomes may be summarized in the following propositions: (1) No direct and unmediated relation exists between simulation and fact-mastery or principles-learning. However, a number of indirect, rather complex relations were observed. (2) Those who preferred the other lab section did better on fact-mastery and principles, i.e., they showed more mean improvement between pre- and post-course scores. (3) In general, those who preferred case, regardless whether they were in case or simulation, did better on fact-mastery. (4) However, those who preferred simulation, regardless of section, scored better on principles. (5) Attendance and fact-mastery were negatively correlated, but attendance and principles-learning correlated positively. (6) The high positive correlations between attendance and principles were among students in simulation rather than case. (7) Negative evaluators had higher mean improvement on fact-mastery than positive evaluators, especially among males in simulation. (8) In general, participation and learning correlated negatively. (9) The strongest relation between participation and learning was among males in simulation.

Conclusions and Implications

The claims we made and the expectations we had for simulation were not borne out. It is not uniformly superior to case studies as a supplementary teaching activity, nor are the exceptions to this generalization quite as we predicted. We expected more differences between personality subsets than were found. Nevertheless, the somewhat pessimistic conclusions from the data should not obscure one important finding: → that behavioral measures of interest reveal simulation to be more involving and more interesting than case studies.

This observation is similar to findings from another recent experimental study of games. (It must be remembered that very few empirical evaluations of games and simulation have been undertaken, so it is a sparse literature to which our results are relevant.) As noted earlier, in four Baltimore high schools, James S. Coleman and Sarane S. Boocock have studied the use of an election simulation (by computer) in two schools and its non-use in two others. They find, and to a greater degree than we did, that the game excites interests and motivates students on virtually every measure of interest. Nothing comparable was found in the control schools without the game.

In spite of this claim for differences between simulation and cases or other materials, the "so what?" question remains: What differences do these differences make for learning? We have pointed out in the section on learning outcomes some differences, but they are [redacted] small. Yet these are differences obtained from small differences in treatment. Virtually everything in the courses was the same for both groups, except for their three-hour laboratory periods held on one afternoon each week. And the number of "treatments" with case and simulation were only eight or nine during an academic quarter.

Moreover, the subjects in this experiment were college students, many of them already interested enough in politics to be political science majors and/or to recruit themselves into these courses. It is important to bear this in mind in assessing the implications of the small differences obtained from this experiment. If there is anything we know from modern studies of political socialization, it is that political interests and skills are often acquired early, i.e., by adolescence, and they are not much altered except by dramatic social events or traumatic personal deprivations. Thus, any differences at all may be regarded as socially and theoretically significant.

Our optimistic interpretation of pessimistic results, our positive reading of small differences, is reinforced by comparison of our findings with those of the San Francisco State College three-year program to develop and evaluate new and different ways of teaching international relations. Charles McClelland's (1962, pp. 269-70) summary of that experience indicates both the difficulty of making any noticeable impact on student learning and a likely explanation of that difficulty:

> The outcome that we have to report is that the course work did not affect the body of students in any significant way that the evaluations could take into account. That is, they did not, as a group, change their beliefs and attitudes perceptibly, they did not gain a greater mastery over the subject matter that was tested for, their understandings of various objects and conditions in the international environment remained very stable and unchanging, and they did not make measurable gains in critical abilities and techniques.
>
> Some tentative conclusions and hypotheses requiring further investigation have been reported earlier on the reasons for the failure of students to change very much. The most important of these is that these students kept firmly in their possession a frame of reference which will accept only a limited amount of information and meaning about international relations and which, also, causes the rejection of those things which did not fit readily into that frame of reference.

The challenge to educators is to find ways to penetrate the firm "set" that college students bring to courses on politics and international relations. Students' perspectives and orientations toward public and world affairs are ordinarily developed by the time they reach college and are largely beyond amendment, except for some unlikely confrontation with an irreversible learning experience. It would be too much to claim, at this point, that simulation constitutes such an experience, but our data indicate small and important differences whereas other methods yield virtually no differences. We cannot yet boldly recommend revision of instructional policies, but we have grounds for confidently recommending further research and replication to help decide whether our vision of an effective technique is a reality or a mirage.

Training

One training use of simulation is in doctoral programs in social sciences. Teachers and scholars in economics, psychology, sociology, and political science are likely to be required in the near future to master a considerable body of material on both computer and non-computer simulation. Simulation is a new direction in experimental research techniques, and doctoral training in social science cannot avoid including it. Some dissertations will be researched with simulation. As a harbinger of this prospect, we may cite Richard Brody's (1963) exploration of the consequences of the sharing of nuclear weapons among several nations, and Michael Driver's (1962) study of the effects of stress upon decision makers' perceptions of nations. Both these dissertations were based on data from the same run of INS at Northwestern in the summer of 1960. Several other examples have been completed or are now in progress at various universities (C. Hermann, 1965; M. Hermann, 1965).

Costs

Innovations deserve to be considered partly in terms of the new costs they impose on the budget of an institution's instructional program. There are "opportunity" or "behavioral" costs for the teachers, expenditures for forms, equipment, etc., and requirements of space.

Some games, like those of the paper-and-pencil variety or mere classroom role-playing exercises, are relatively inexpensive. For these games, the chief outlay is that of the teacher's time and imagination in writing a scenario of the kind Susan Leiberman (1962) prepared to introduce her third-graders to the proposition that the United Nations is more than a building on a postcard. The design of any simulation involves this investment, and for the complex and long-running games it can be a heavy one. At Northwestern several years of graduate assistants' time, not to mention the sustained labors of a full professor, have gone into the development of Inter-Nation Simulation. At Carnegie Tech, four or five faculty members devoted several months to the initial work on a management game, and additional time has come from other colleagues who have served as auditors, as members of boards of directors, and in other supervisory roles during the conduct of games. Time given to designing and learning games is time denied to other activities of scholarship and teaching.

Costs for the actual conduct of a game may be illustrated again by the use of Inter-Nation Simulation at Northwestern. Alger (1963, p. 165) estimated that a single run of three hours added sixty-five dollars to the budget for one of his courses; in an academic quarter of ten weeks, the additional cost was six hundred and fifty dollars.[6] This includes expenditures for student help, decision forms, message forms, secretarial time, typewriter rentals, calculator rentals, and so forth. It assumes, however, that some equipment is already available—for example, laboratory space, tables, chairs, in- and out-baskets, and clocks. Our use of simulation in teaching at Northwestern and at Ohio State has not required purchase of some of this "capital" equipment because it was already available for research. What it would cost to replace this equipment is hard to estimate. If laboratory space, or the equivalent, is not available, running the simulation is out of the question. At one institution, faculty offices have been cleared for a weekend's run, but this is surely unsatisfactory for a regular activity. Otherwise, the strain on inter-departmental comity can be an obstacle to further gaming.

Even the expenses for simulation for doctoral research run higher than ordinarily. Two dissertations were recently written at Northwestern from eleven runs of ten hours' duration each. Counting the "overhead" charged by the university on research contracts and grants with government agencies, these two dissertations → cost fifteen thousand dollars each. Where is the university that will allocate that amount of its own money to graduate students' research?

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[6] A careful accounting of costs of a laboratory section in Fall, 1963, was very nearly the same as Alger's earlier estimate.

Policy Recommendations

In conclusion, it is appropriate to suggest ways for consolidating, as well as initiating, simulation gains. A number of alternative policies are available to governmental and private institutions dedicated to sharing enlightenment and enhancing skills. Some of these relate to disseminating information about simulation and games more widely, and others bear on establishing a firmer base of knowledge of the use and consequences of simulation.

Training manuals

Except possibly for business games, the use of simulation has been confined largely to educational elites, such as are found in the graduate schools and in government. At present, diffusion of information about and instructions for using games depends ~~heavily~~ on word of mouth, personal visits, and the narrow circulation of incomplete dittoed or mimeographed materials characteristic of innovations in research and educational institutions. Wider use and better use depend on publication of workbooks or manuals with instructions sufficiently detailed and complete that teachers and students can put the model into operation without any further help. These manuals of procedures should contain copies of all forms to be used in any given game, such as the forms on which messages are recorded and published, the documents that represent the basic characteristics of the game, and all supplementary materials required for conducting a single exercise. Ideally, such manuals should also include options for the use of a particular game, so that simple but reliable modifications could be made in order to extend the use of the simulation to other related purposes.

There are now enough operational simulations in use by teachers at several institutions that a half dozen or so modest Office of Education contracts could result in as many manuals within a year or two. Thus, it would not be difficult to extend and improve the dissemination of these new techniques.

Films

Similarly, mastery of such new techniques as simulation and games could more quickly be realized by an accompanying half-hour film would show the game or simulation in operation. This would stress the units, concepts, roles, and activities of the whole simulation, as well as focus on particular points to be learned. Among the shots to be included in such a film would be a case-like following of a particular nation or firm throughout a whole period of the game, so that the primary activities of the simulation could be illustrated in depth as well as introduced in breadth.

In order to disseminate more general information about a number of games, an hour-long movie covering several different kinds of simulations should be produced. This ought to be available to high schools, junior colleges, and universities in which teachers and administrators contemplate adopting new media and techniques of instruction.

These visual media for introducing others to simulations and games are especially necessary in the judgment of many of the scholars who have invented these new techniques. They are frequently called upon to describe their games, and a well-packaged set of films would, in the aggregate, be a reasonably inexpensive means of communicating these new developments and would probably be an efficient way of doing so. In all cases, of course, the film should be made with the advice of those who have created the games, but the skills of those who are specialized in communicating by film and related visual modes would surely help in devising effective ways of presenting the new techniques to wider audiences.

Research relevant to the evaluation of the new techniques

Strong judgments about the values of games and simulation for teaching and training should await the completion of research evaluating particular simulations both intrinsically and in relation to alternative forms of instruction. The number of projects critically evaluating simulations is still too small, only the efforts at Northwestern and Michigan are known to the author. Further studies can justifiably take any of several objectives, depending upon the researcher's interest in short- or long-term outcomes of the techniques, his interest in teaching undergraduate students or in training specialists for particular occupational roles, or his concern for assessing effects for aggregates of students or for individual types.

Many topics deserve a prominent place on the research agenda, but one should like to emphasize the critical importance of investigating the usefulness of games and simulation for different age groups. As has been said, research in political socialization indicates that political attitudes, values, and orientations are acquired principally during adolescence or pre-adolescence. By the time most students have an opportunity to participate in the newer techniques of political and social science instruction, they probably have already, consciously or unconsciously, adopted their "set" toward politics and society. If one of the tasks of education is to help people to clarify their values and to find means to achieve their goals, the consequence of delaying political and social science work until late adolescence or early adulthood may be that a large segment of society is deprived of the opportunity to engage in systematic clarification of values about politics.

Therefore, those concerned about this social problem would welcome the development of instructional media and techniques that introduce people at early ages to the concepts and problems of political analysis. Because games and simulations are abstract, they can afford to save the student from many of the details and minutiae that he ordinarily discovers when confronted by the real world, but at the same time introduce him to what research has uncovered to be the central and distinguishing characteristics of political behavior. As the student grasps the essentials of one game, he can ~~then~~ appropriately be introduced to more complex games, thus first seeing a tree and then encountering a forest, but without losing his appreciation for the basic concept of tree.

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Table 1.--Summary of Ten Interest Measures for Twenty-Three Groups

Groups	Perceptual Measures					Behavioral Measures				
	A*	B	C	D	E	F	G	H	I	J
1. All students	—**	—	—	—	PC	—	—	PS	—	PS
2. All males	—	—	—	—	PC	—	PC	PS	—	PS
3. All females	—	—	—	—	PC	—	—	PS	—	PS
Males										
4. High N Ach	—	—	—	—	PC	—	—	—	PS	PS
5. Low N Ach	—	—	—	—	PC	—	PC	PS	PC	PS
6. High N Aff	—	PS	—	—	PC	—	—	PS	PS	PS
7. Low N Aff	—	—	—	—	PC	—	—	—	PS	PS
8. High N Power	—	—	—	—	PC	—	—	PS	PS	PS
9. Low N Power	—	—	—	—	PC	—	PC	PS	PS	PS
10. Concrete cognitive style	—	—	—	—	PS	PC	—	—	PS	PS
11. Moderately concrete cognitive style	—	—	—	—	PS	—	—	—	PS	PS
12. Moderately complex cognitive style	—	—	—	—	PC	—	—	—	—	—
13. Complex cognitive style	—	—	—	—	PC	—	—	PS	PS	PS
Females										
14. High N Ach	—	—	—	—	PC	—	—	PS	PC	PS
15. Low N Ach	—	—	—	—	PC	—	—	PS	PC	PS
16. High N Aff	—	—	—	—	PC	—	—	—	PS	PS
17. Low N Aff	—	—	—	—	PC	—	—	PS	PC	PS
18. High N Power	—	—	PS	—	PC	PS	—	—	PS	PS
19. Low N Power	—	—	—	—	PC	—	—	PS	PS	PS
20. Concrete cognitive style	—	—	—	—	PC	—	—	PS	—	PS
21. Moderately concrete cognitive style	—	—	PC	—	PC	—	PC	—	PC	PS
22. Moderately complex cognitive style	—	—	—	—	PC	—	—	—	PS	PS
23. Complex cognitive style	—	—	PS	—	PC	—	—	—	—	PS

*Columns correspond to the following variables:

A. Perception of amount of reading on subject (differences analyzed by chi-square test)

B. Perception of relative course interest (chi-square test)

C. Perception of interest in course (chi-square test)

D. Perception of interest in political science (chi-square test)

E. Perception of interest in lab section (no test of significance)

F. Behavioral interest expressed by reading (t test)

G. Behavioral interest expressed by visiting professor (t test)

H. Behavioral interest expressed through attendance (t test)

I. Course evaluation essay (number of cases too small for test of significance on any groups except all students, all males, all females)

J. Behavioral interest expressed by rate of participation in lab section (t test)

**A blank line indicates no significant difference between case and simulation sections in amount of interest observed by indicators for this variable. PC (Pro-Case) indicates significantly more interest in case section, except in column E for which

Table 1--Continued

no test of significance was possible for small groups. PS (Pro-Simulation) indicates significantly more interest in simulation section. A 0.05 level of probability was used to define significance.

Table 2--More Simulation Students Prefer Case Than Case Students Prefer Simulation

Section	Section Preference			Total
	Case	Simulation	No Response	
Simulation	26	44	1	71
Case	46	15	2	63
Total	72	59	3	134

Table 3-a.--Among All Students, Those in Simulation Have Higher Attendance Scores than Those in Case

Section	Mean Attendance Score
Simulation	57.3239
Case	48.7460
Difference . . .	8.5779*

*Significant at 0.05 level as determined by t test.

Table 3-b.--Males in Simulation Have Higher Attendance Scores than Those in Case

Section	Mean Attendance Score
Simulation	58.5957
Case	50.4048
Difference . . .	8.1909*

Table 3-c.--Females in Simulation Have Higher Attendance Scores than Those in Case

Section	Mean Attendance Score
Simulation	54.8333
Case	45.4286
Difference . . .	9.5865*

Table 4.--Among All Students Commenting Either Positively or Negatively There Is No Difference In Behavioral Interest Expressed Through Course Evaluation

Section	Comment		Total
	Positive	Negative	
Simulation	15	20	35
Case	11	18	29
Total	26	38	64

$X^2 = 0.167$, not significant at 0.05 level.

Table 5-a.--Those Who Prefer The Other Lab Section Tend To Improve More

Preferences	N	Mean Pre-Post Improvement	
		Fact-Mastery	Principles
Males in Case preferring Case . . .	30	9.5667	8.3333
Females in Case preferring Case . .	18	11.3333	9.5556
Males in Simulation preferring Simulation	31	11.0323	11.4184
Females in Simulation preferring Simulation	13	4.8462	7.2308
Males in Case preferring Simulation.	12	9.6667	14.5833
Females in Case preferring Simulation	3	4.0000	17.0000
Males in Simulation preferring Case.	16	13.5625	7.0625
Females in Simulation preferring Case	11	18.9091	14.6364

Table 5-b.--Correlations Between Attendance and Fact-Mastery and Fact-Mastery and Principles-Learning for Males and Females in Case and Simulation

Attendance	Fact-Mastery	Principles
Case Males	--0.3023	0.1182
Case Females	--0.3553	0.0412
Simulation Males	--0.0345	0.1632
Simulation Females	0.1164	0.2441

Table 5-c.--Those Who Evaluate Their Section Negatively Tend To Improve More

Evaluation	N	Mean Pre-Post Improvement	
		Fact-Mastery	Principles
Case Males, positive evaluation	6	7.0000	5.3333
Case Males, negative evaluation	9	10.0000	9.8889
Case Females, positive evaluation	5	11.2000	0.0000
Case Females, negative evaluation	9	15.7778	14.1111
Simulation Males, positive evaluation	10	4.7000*	6.9000
Simulation Males, negative evaluation	12	16.6667*	13.9167
Simulation Females, positive evaluation	5	1.4000	9.8000
Simulation Females, negative evaluation	8	4.1250	13.5000

*The differences between these means are significant at 0.05 level as determined by t test.

Table 5-d.--Correlation Between Fact-Mastery and Principles-Learning and Rate of Participation for Males and Females in Case and Simulation

Participation	Fact-Mastery	Principles
Case Males	--0.1106	--0.2771
Case Females	0.0489	--0.0160
Simulation Males	0.3273	0.2288
Simulation Females	--0.1909	--0.4786

CHAPTER IV

PROGRAMMED INSTRUCTION AND TEACHING MACHINES[1]

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The transition from the little red school house to the computer-based school system is one of the more dramatic and significant developments taking place in the shadow of the space race and in the climate of the cold war. Important in this transition from mass education of individuals to individual education of the masses are the teaching machine and programmed instruction. Together these technological innovations are stimulating substantial amounts of research and development, as judged by typical educational standards, but when judged by the standards of space technology they do not add up to that which has gone into a flight to the moon.

The purposes of this chapter are fourfold: (a) to consider some problems in the sociology of innovation in relation to events in programmed instruction; (b) to present the basic concepts of programmed instruction (PI) and teaching machines (TM); (c) to discuss findings from research on PI, and (d) to consider the implications which the concepts and findings hold for the future of education and society.

The Sociology of Innovation

The sociology of innovation is an important but frequently overlooked aspect of an emerging field such as programmed instruction. It seems useful to consider the processes of technological innovation in education before presenting the basic concepts of programmed instruction. This discussion of the general processes will be related to the developments in programmed instruction in order to place that particular innovation in perspective. The purpose of doing this is to identify ommissions, problems, and guidelines for future consideration. The intent is to provide the pattern and texture of the technological fabric that is currently being woven on separate looms and without an overall design.

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[1] The author is grateful to USOE, Title VII project No. 2-20-003 and ONR project No. 3985(04) for providing the opportunity to work on this manuscript and to work on some of the problems discussed here.

Innovations seldom occur without historical roots, or in the absence of competition. The roots of programmed instruction lie mainly in psychology and in educational psychology, and date back to the early work of Pressey (1926), who saw in the process of reinforcement the potential for a technological revolution in education. He conceived of the teaching machine as an adjunctive device that could either test students, or provide them with immediate knowledge of results when used for teaching. This was an important first step in the automation of instruction, but the anticipated impact of this notion failed to materialize in any substantial way until thirty years later when Skinner (1954, 1958) wrote his now classical paper on teaching machines. The interval was not completely void of activity, however, for during World War II individual instructional procedures were developed to teach technical skills (Valentine, 1947).[2] In addition, Pressey and his students continued to conduct research, and to develop a variety of reinforcement devices (Pressey, 1950). Skinner (1954, 1958), on the other hand, not only stressed the reinforcement aspect of the teaching machine, but also integrated it with a set of stimulus materials, the program. Unlike Pressey, he saw the teaching machine as an autonomous device which would provide a tutorial experience without the intermediation of a live teacher.

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[2] See Stolurow and Davis (1964) for a discussion of the use of phase checks for training and testing.

Unlike many of the competing technological innovations, programmed instruction and teaching machines were developed explicitly for education. Films, tapes, and television, on the other hand, were developed in the entertainment industry for entertainment purposes, and later adapted to education. Coming as it does from a background of psychological theory and research, programmed instruction has continued to have criteria and standards associated with its development that are quite different from those of other innovations. It is characteristic of the procedure for developing programs, for example, to include a research effort which is designed not only to determine the instructional effectiveness of the program, but also to find answers to scientific and technological questions. Also emerging are studies relating to theories of teaching and to the decisions required in instruction. As this line of research becomes more vigorous and seminal, more substantial theories of teaching will be produced. At the present time, however, the field is in a paradoxical state where a technology of instruction is being used more to study the psychology of learning than to study the psychology of teaching. Since programmed instruction is an active approach to teaching, it forces the development of theoretical notions about instruction, because instructional decisions must be built into every program.

The traditions of psychological research on learning have been the model, although not always the practice, in studies of PI. As an important part of this tradition there has been widespread acceptance of the need to use criteria which are directly related to student learning. Consequently, in studies evaluating the effectiveness of PI, student performance on achievement tests is considered to be the most critical type of data. Validity is a fundamental requirement. Consequently, the achievement test, when used to determine the effectiveness of a program, must be demonstrably, and usually directly, related to the program. In hypothesis-testing studies, the difference in average student performance following one experimental treatment has to be significantly different statistically from that following an alternative method of instruction. This rigorous demonstration of effectiveness is not insisted upon with many other competing innovations. It is not typical in making decisions about educational innovations to insist upon a statistically significant difference. In fact, the whole matter of making decisions about using or not using a suggested educational innovation usually depends upon administrative convenience, economic savings, and teacher acceptance. It is quite apparent that the evaluation of various innovations involves methods and criteria that tend to be determined by each innovation's field of origin. When an innovation is primarily administrative or logistical, ~~different~~ criteria are used in evaluation studies different from those used when the innovation is instructional or curricular. With innovations such as team teaching and the ungraded primary plan, effectiveness is determined by administrative feasibility and convenience; in the case of programmed instruction there is typically an insistence upon a demonstration of greater degrees of student learning, student retention, and transfer. An hypothesis relating to this difference is that the attitude toward innovations in education is characteristically shaped by a more fundamental assumption; namely, that information transmitted to the student is always learned. This might be called the communication-learning fallacy and it seems to have greater affinity for some innovations than for others.

It is interesting and significant to note that this fallacy is most prevalent in the selection of textbooks. Seldom, if ever, is a textbook selected on the basis of its known effectiveness in producing greater student learning, retention or transfer. A variety of texts have been available for a number of courses for many years, yet there are practically no experiments comparing one book with another in terms of student achievement on an objective test designed to measure what the students have learned from text reading. On the contrary, programs have been available for a very short time, yet a large proportion of programmed learning studies have compared programs in terms of student achievement. Thus, it would appear that in the case of books there is a strongly held attitude that they need only be read to be learned. In programmed learning, however, the basic assumption is that the program is to be written in a large measure by the students with whom it is to be used. Consequently, student errors are examined carefully for evidence of the program's failure to teach.

Since textbooks are selected on the basis of teacher appeal and judgment regarding their suitability for students, it would be interesting to know the correlation between teacher judgment and actual effectiveness as measured by an objective test of student achievement. Rothkopf (1963) has reported a -.75 correlation between teacher judgments regarding the difficulty level of programmed frames and student performance, indicating that with programmed materials, teacher judgments are inversely related to actual difficulty. This finding is particularly interesting in view of the fact that the participating teachers had just completed a course in PI.

Not only are books of undetermined value as instruments of behavioral change, but also teacher judgments of them are of unknown validity. Programs, on the other hand, have specified degrees of effectiveness, determined by student performances, for one or more groups of students. This information is supplied by the publisher in a manual accompanying the program.[3]

The materials associated with various innovations also differ from one another, and usually one should have an explanation of the materials and procedures to be able to understand the theory behind them. Consequently, new teaching methods and their rationale are taught to instructors who train student teachers. Usually, the teachers learn about the method and are given an opportunity to learn to use it under supervision. The typical materials developed to implement a method are only illustrative and usually are not adequate for instruction. The materials of PI, on the other hand, are designed to be self-sufficient for the student. This has led to the mistaken impression that they also are self-sufficient for the teacher. However, the teacher who wants to know the rationale would have a difficult time discerning it from an examination of its frames.

The procedures associated with the development of programs are detailed and rigorous (Markle, 1965). While designed to provide materials of known effectiveness and uniform quality, they are time consuming and costly in comparison with procedures associated with more traditional instructional materials. In fact, it is difficult, if not impossible, to compare the cost of program development with the cost of a book, since there is typically no accounting of the cost of writing a textbook--not the case in writing a program.

Films, educational television, tapes, and magnetic tapes, as more traditional materials, are different from self-instructional programs in that they focus on larger groups of students, whereas the self-instructional program focuses on the individual student. In addition, programs are prepared on the basis of both the "fine and coarse grain" analyses of behaviors required to achieve an instructional objective. The steps of a program are a synthesis of a subject matter with a strategy of teaching.

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[3] See Jacobs, Maier and Stolurow, 1964; Joint Committee on Programmed Instruction and Teaching Machines, 1962 Interim Report.

Programmed instruction as an innovation

The concepts of programmed instruction are far reaching in their implications. Programmed instruction has many different, but specific, implications for educational practice, one of the most important of which is individualized education. Programmed instruction is not a technique, although it has implications for educational technology. It is not a method, although it has implications for educational methodology. It is probably most adequately described as a philosophy for the education of the individual student which is based upon a psychological analysis of the teaching-learning process as it takes place through the use of an educational dialogue between teacher and student. Programmed instruction is an innovation in the implementation of individualized or tutorial instruction.

Programmed instruction is neither coordinate with educational media nor with approaches to group management or logistic problems such as team teaching and the ungraded primary. Many different media can be, and are being used to implement programmed instruction. On the other hand, the products and methods of programmed instruction can be used in team teaching or in an ungraded primary curriculum. Programmed instruction deals with the management of people. An auto-instructional program could be a member of the team teaching one of the sources of instruction in an ungraded primary plan.

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Innovations require context changes

Programmed instruction is an alien philosophy in the current American educational scene, even though it has an American birthright. In contrast with group or mass instruction, the now prevalent procedure, PI is a commitment to individualized instruction and to the facilitation of individual rates of progress. The basic notion is the adaptation of instruction to the

Programmed instruction is an innovation in education in that it takes individualized instruction seriously by using the systems approach to the problem. While the elements are not new to education, the explicit way in which they are interrelated and implemented represents an innovation in the proper sense of the term.

individual student's need, rather than the adaptation of the individual to the instructor's needs or to administrative convenience. Consequently, it is at loggerheads with the prevailing practices and laws governing American education. In the current scene in the United States and most of the world, education, in the final analysis is correlated with the passage of particular units of time rather than with the passing of an achievement test. In fact, when students are skipped or failed they are moved ahead or held back a year, no more, no less. They are not accelerated or decelerated selectively by amounts that are determined by achievement test scores in specific areas. Students are required to go to school until they have reached a certain age, not until they have achieved a particular minimum level of achievement that is commensurate with their ability. This equation of time in school with educational progress has a ring that suggests a basic kinship to the aging of beer; however, we now have processes for speeding up the aging of beer. In spite of the availability of processes for speeding up education these processes are not widely used in the schools.

Institutions differ greatly in the degree and speed of their responsiveness to innovation. Not enough schools are using PI. Even in the schools where PI is used, students who go through a program most rapidly often must wait for those who go through much more slowly. What students do when they finish ahead of the others becomes a problem when PI is used in a school setting where a group's progression is the basis for the modus operandi. In short, if students were to begin and end an educational unit as individuals rather than as a group, this would not be a problem. To use the methods of programmed instruction effectively, it is necessary for the schools to have a total plan that accommodates the fast learner and provides him with rewarding rather than punishing experiences for early mastery. This means that levels of acceptable accomplishment have to be agreed upon and used in making decisions about progress, and that appropriate tests have to be developed to determine mastery levels. For these reasons, basic changes in educational thought and action are required if programmed instruction is to survive, let alone grow and develop within education. Whether the schools will prove to be sufficiently flexible to accommodate a completely individualized system of education or not remains to be seen. The transition is bound to be difficult, but if it is to be accomplished many associated changes obviously need to be made by the utilizing institutions. Bassett High School, near Los Angeles, and Florida Atlantic University are examples of institutions to be devoted to the general philosophy of PI.

Industrial and government training programs are not committed to a lockstep group progress plan. Consequently, they can accommodate programmed instruction with less difficulty. In fact, they are adapting to the requirements of programmed instruction which is currently receiving its most enthusiastic support from industry and government. Training programs in these institutions are being modified to accommodate these requirements. Both industry and government are keenly sensitive and quickly responsive to the economic advantages of accelerated learning. The aspect of adaptation that appears to be most difficult for these institutions is the shortage of good quality programs to meet their needs.

Systems approach

To properly accommodate an innovation that has fundamental implications for the institution to which it applies, a systems approach is useful, if not necessary (Stolurow, 1964a). To date, however, this approach to the analysis of educational problems has not been widespread.[4] Rather, the efforts to determine the feasibility and effectiveness of programmed instruction have been singularly restricted to the use of one or two programs in a school or throughout a school district, and the use of these programs has been accomplished within the prevailing social context of group instruction. The existing system has not been altered to accommodate programmed instruction. When a tryout is conducted under these conditions there is a great risk of rejecting a useful concept simply because the supportive changes necessary for adequate testing are not made by the system. The kinds of innovation that can survive when only superficial changes are made in the social context are those that represent only slight departures from the prevailing conditions. Only departures from existing practices which require minor variations in the prevailing social context could be accommodated without being vitiated. Obviously, the number of innovations that can be shown to be effective under these conditions is likely to be small at best. This is a potentially important problem with programmed instruction, since it is possible to reduce if not eliminate the effectiveness of a program if students who finish clearly ahead of the others are given undesirable tasks to perform, such as being asked to "police" the school grounds.

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[4] A conference on New Dimensions for Research in Educational Media Implied by the Systems Approach to Instruction; sponsored by USOE Title VII and organized by Professor Eugene Oxhandler, was held at Syracuse University, Syracuse, New York. April 2-4, 1964.

Teaching machines as innovations

A teaching machine is an instructional mechanism used to produce systematic behavioral changes in a student whose responses to the material presented determine the further operation of the mechanism. In this definition "mechanism" refers to a set of functions or transformations, not to a physical entity. The scientific conception of the teaching machine is general and abstract rather than specific and concrete. Teaching machines that are in use are exemplars of the general concept. Each variation accomplishes a set of functions and therefore is described as being adaptive to some degree. Some accomplish the same set of functions as other exemplars and at the same level of adaptivity, but in a different way (Stolurow, 1961; Stolurow and Davis, 1964).

While there were practically no machines developed after Pressey's except those with which he was associated, there has been an apparent proliferation of teaching machines since Skinner's 1958 article which reactivated interest in the concept and redefined the direction of its development. If the accomplishment of a set of functions rather than its physical appearance defines a type of machine, then the number of different types of machines is actually very small, while the number of machines is fairly large (Finn and Perrin, 1962). The primary proliferation has occurred with the minimally adaptive machines of the type originally developed by Pressey (1926; 1950) and independently by Skinner (1958). Pressey was only concerned with providing immediate knowledge of results. Popular support for the idea of a teaching machine seems to have outstripped the creative energies of machine designers. The designers have tended to fixate on the same set of functions and only have varied the way in which these functions are accomplished. In a way, this result suggests either a failure to understand fully the concept of the teaching machine, or a failure to appreciate the potential significance of all of its implications.

Crowder's AutoTutor,* for example, represents an effort to build into a machine the capability of implementing a set of decisions based upon the student's responses to a pre-programmed set of materials. Pask (1957, 1959a, b, c) has been developing still more adaptive systems, i.e., those that learn about the student and base their decisions on more information and even types different from that provided by the correctness of the last response.

While the use of a modern high-speed computer in a teaching machine system suggests that the system is, in fact, highly adaptive, this is not necessarily the case. It also is possible for a computer-based teaching machine system to use its computer simply as a data processing mechanism. The important, and potentially significant, use of computers in teaching machines lies in using them both to monitor student responses and to make decisions about the strategy to be used in teaching an individual student (Stolurow and Davis, 1964). Unfortunately, early efforts to use computer-based teaching machine systems in this country were simply demonstrations that one could get a monstrous machine to turn pages for the student and record all his responses (Coulson, 1962).

For the most part, the teaching machine connotes to the layman a box that sits on a desk and has a knob which is turned to move paper past a window that reveals the frames of the program. This, of course, is the level of machine development at which the industry has settled, and research has centered. It may be useful to consider the reasons for the apparent ineffectiveness of these minimally adaptive teaching machines (Goldstein and Gotkin, 1962). One possible explanation is that students who used these machines were already highly proficient in doing for themselves everything that the machines were designed to do. Consequently, when the performance of students who were taught with a program in this type of machine were compared with those who were taught by a program alone, the results failed to show a difference. In fact, the typical finding is that there is no difference of statistical significance between scores achieved by a group that uses a machine with a program and a group that uses only a program. While many things have varied from study to study, a common condition is the use of linear programs and minimally adaptive machines. The linear program typically has a low error rate so that the chances of finding a difference are minimal. Therefore, we cannot conclude from these studies that all programmed textbook presentations are equal in effectiveness to all machine presentations of the same program. In short, these studies cannot be generalized to more adaptive machines or to programs with larger step size. Of the eight studies reviewed by Goldstein and Gotkin (1962) the lowest age groups were composed of fourth graders. Thus, it appears that by this age, if not sooner, children have mastered the skills for which a minimally adaptive machine might compensate. It is possible that a minimally adaptive machine might be useful to younger children but this remains to be demonstrated. For example, the minimally adaptive machine might provide greater contiguity than the student can provide for himself.

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*Trademark.

The method by which particular functions are accomplished may be trivial educationally, but important economically, or vice versa. Typically the method of accomplishment is more critical in relation to cost, convenience, and the resources available than it is in relation to student achievement. However, it also may be true that a method of accomplishment has psychological implications that relate to the efficiency of learning. Smith and Moore (1963), for example, found that high school students who studied with a conventional text did not perform as well as those who used a program in a machine. Differences were found on both immediate and delayed posttests. These results must be considered carefully, since Alter and Silverman (1962), for example, used college students in a comparative study of a conventional text and found no difference. Two factors could be operative here, either of which might account for this disagreement. One is the students' level of reading comprehension. The other is their familiarity with the language and concepts being taught. Students who would achieve high comprehension scores have gone beyond the level of a typical small step linear program, provided the language and concepts being taught are not very unfamiliar to them. The ability to read ordinary textbook prose can be considered the terminal behavior level of one aspect of reading skill. Thus, reading a linear or even a branching program could be considered as a transitional stage to that terminal level. Students who have achieved the terminal level would not be expected to benefit from a program unless the terminology and concepts were very unfamiliar to them. Conventional linear programs usually provide steps that are too small for the mature reader of prose and a machine presentation may confound the situation by slowing down reading rate because of the slow mechanical method of moving the program which is repeatedly required. Adequate assessment of the student's entry behavior level could have revealed the validity of this possibility.

Instruction as a Systems Concept

Before considering the use of programmed instruction in education, it is necessary to examine it as a process. To begin with, it is assumed that the process of instruction is one that lends itself to a systems analysis and an engineering approach. While teachers do not normally think of themselves as engineers in the general sense of the term, the kind of thing that they do whenever they plan and carry out instruction is a type of engineering. The teacher plans and literally constructs an educational environment, the purpose of which is to shape student behavior and thinking. The forms which behavior can take and should take to meet selected criteria, or performance standards, in terms of both efficient learning and eventual performance, are a matter for future research. In fact, this is the frontier of educational research.

One way of proceeding is to use a systems approach in analyzing instruction (see Stolurow, 1961; 1964a). Doing this has the dual advantage of freeing one from the theories of the past and of providing a means of coping with a large variety of innovations such as educational television, films, tape recordings, language laboratories, and teaching machines.

insert Figure 1 here

Not every educational innovation relates directly to instruction, but those that do need to be placed in a common perspective so they can be related to each other. The model in Figure 1 is heuristic in that it makes explicit the elements and relationships which must be considered in developing a learning environment. It is called the instructional system and consists of these six elements as pictured in Figure 1: (a) the input, (b) the student, (c) the output, (d) the feedback, (e) the performance standards, and (f) the task. Each element represents a different set of critical functions which collectively represent the system.

Input

The first component--the input--represents three system functions: They are: (a) cue, (b) elicitor, and (c) reinforcement, or feedback.

The cue is the stimulus input to which the student must become sensitive. He learns to discriminate the cue from similar stimuli and responds to it in a different way.

The elicitor, on the other hand, is the stimulus input to which the student is already sensitive. He does not have to learn to make a desired response to it. In fact, it is selected because it is already capable of eliciting the desired response. Whereas the cue secures the learner's attention, the elicitor makes a desired response highly probable, i.e., in the presence of the cue. One of the most widely used classes of elicitors is language. If we want a hard "c" sound, we ask the student for it and are likely to get it with a high degree of consistency. However, we do not always have available the elicitor we want, and often have to use more than one to obtain a complex response. In choosing among elicitors, response speed and reliability are important characteristics. With increasing age, language provides a greater and greater service as the elicitor of responses.

The reinforcer is a third function which input stimuli can provide. Whereas cues and elicitors precede the critical response, the reinforcement follows it. Reinforcement stimuli are a special set of feedback stimuli; they are the set which increases the probability of the response on future presentation of the cue. A part of the feedback is internal as when an individual feels the motion of his hands or hears his own voice saying something.

A part of feedback is external as when the student hears the instructor say "correct," or when the student sees the right answer at the back of the book.

Student

The student is the next component in the model. The two main functions of the student are as a transducer and as a learner. As a transducer, visual, auditory, and other sensory input are translated into response output. As a learner, the relationship between a particular input and a specific output becomes modified over time. The rate at which the transducer function changes over time is one critical aspect of learning. We can obtain certain data about the student before a particular learning experience takes place, such as his general intelligence, his level of specific aptitude, his personality profile, and beginning knowledge in relevant areas. These data predict the type of educational experience that is most effective in producing particular performance changes or specific learning. The student's general intelligence is not a predictor of the amount of change that will take place with a given educational experience (see Woodrow, 1946). Specific aptitude measures predict this better than general intelligence (Stolurow, 1960; 1961), and early learning trials do not predict remote ones as well as aptitude measures do (Parker and Fleishman, 1960; Adams, 1953).

Motivation also is important in determining rate of learning and seems to increase multiplicatively with associative capability, for no learning results without motivation, regardless of the student's basic capability or aptitude. One way of assessing a student's motivation level is in terms of personality characteristics, e.g., perceived needs (see Frase, 1963). In order to predict and develop some of the changes in students during a learning experience, it seems useful to determine personality characteristics. Starting with the student's intelligence scores, his initial level of performance on the task can be predicted. The test score he achieves is the measure of his actual knowledge of the task, and it can be compared with the expected score predicted from the intelligence test to determine the discrepancy score. This score can be used to measure the effects of different treatments (Du Bois, 1962). Therefore, it can be considered as a measure of the student's motivation level, for example. Treatments that are used to promote rate of learning should affect the discrepancy score. Personality and interests must be considered in relation to different aspects of the learning experience (e.g., Frase, 1963). The theory is that these characteristics of the student relate to his motivation. Consequently, student's personality scores are to be considered in relation to the nature of the external feedback which evaluates the student's responses. The student's motivation while learning from a specific set of materials can be increased or decreased, depending upon the relationship between his interests and the examples and references made in the material to specific domains of interest. To a female student interested in cooking, a set of references to automotive repair would be uninteresting; the same physics principles related to baking might be interesting to her.

Output

Behavior in the form of specific responses or sets of responses constitutes the output of the instructional system. The objectives of instruction are typically formulated in terms of the kinds of behavior (output) which the learner will be able to perform after having successfully completed training. In addition to the qualitative aspects of the student's behavior (e.g., the specific responses) the task engineer is concerned with the response latency and response speed. Latency refers to the interval between the appearance of the input (cue-stimulus and possibly elicitor) and the beginning of the response output. Speed, on the other hand, is the time from the beginning to the end of the response itself, e.g., the travel time, the time used in writing an answer, or the actual selection time involved in making a choice from among a set of alternatives. Since transducer rate is an important system parameter, it is appropriate that time measures should be used in evaluating different instructional strategies. Where possible, different steps in the transduction process should be measured separately.

Feedback

As indicated in Figure 1, all output is accompanied by some input that elicits or evokes feedback to the trainee. In this sense the instructional system is a closed loop. Two forms of feedback can be distinguished:

(a) the automatic by-product of response which is internally generated and response dependent, and (b) an externally introduced stimulus usually provided by a teacher, which, for example, may tell the student that he is right or wrong. It also may tell him why, and even evaluate the quality of the response. The four aspects of feedback that seem to be important in determining the rate at which behavior output becomes shaped or modified to fit certain performance standards are (a) punctuation, (b) providing cues, (c) supplying information, and (d) altering or sustaining motivation. Different aspects of feedback may provide any one or more of these functions and with varying degrees of efficiency. The "built in" neurological channels that provide internally generated feedback via inter~~r~~oceptors have an advantage over the externally imposed feedback; the internally generated feedback is usually delivered more rapidly and reliably. However, the information provided by internal mechanisms is not always salient or easily interpreted, and usually is most critical for learning skills. For example, the feel of a good golf swing is something that is recognized only after the learner has a good deal of experience in swinging a golf club. Thus sometimes there is a trade-off of salience for speed and reliability. Feedback can punctuate experience, provide cues, inform, or motivate the learner. Any particular example of feedback may serve one, or more than one of these functions. The effect of feedback is determined by these functions and by the needs of the student at the time the feedback is delivered. Consequently, each function should be considered when a task is being developed. Unlike other forms of instruction, in programmed self-instruction each function can be considered in relation to every response.

Performance standards

The standards used in the evaluation of the student's performance determine the feedback that is given him. The failure of the trainee's response to match the performance standards is what provides the error signal that gets feedback to the trainee. In this way he receives in- and out-of-tolerance information. Training standards, as well as content, must be programmed whenever it is decided that they should vary throughout practice.

For example, the decision might be to accept a larger amount of variation in response during the very early trials in practice, but not later on. Consequently, there are both fixed performance standards which apply at a stage of practice and variable performance standards that change with the stage of practice.

One form in which a performance standard may be used is simply as the correct answer to a problem. This is an example of a specific performance standard. However, in addition to the use of the specific form, there is the use of the general form, e.g., a principle or rule. In fact, the general form is the standard itself and it might be taught to the student. Doing this permits the student to evaluate his own performance. For example, a student may learn a spelling rule, and then, when he writes a letter or theme he may check his own writing by applying the rule to see if he violated it. The same process might be repeated as he checks his writing for conformity with grammatical rules. In mathematics the learner may check his work by seeing if he employed particular principles, like associativity or commutativity, as he examines his solution to a problem. Whenever the student is making this type of use of specific information or rules, he is employing a performance standard to generate his own feedback signal. Even the voluntary use of a dictionary to check spelling serves this function. Thus teaching these skills to students moves them from the level of a teacher-dependence to self-teaching. A complete instructional program includes performance standards and skills for self-evaluation as subject matter at appropriate

performance standard to explicate the function.

This brief analysis of performance standards points out the two ways in which they function. One is to generate the expected right answers that are built into a program ahead of time; the second is to generate, on the spot, the information (usually in the form of checks) which the individual learner can use to provide his own error signals. The latter indicates he has achieved a relatively high level of proficiency.

R

Task

There are two parameters of a task. One is a set of stimulus inputs encoded according to a set of rules. These are programmed or sequenced stimulus inputs that are encoded in a particular way and manipulated according to a set of rules. The second is a corresponding set of performance standards used to evaluate each response output. Tasks are changed by altering either the nature of the input--the encodings in terms of syntax or sequences--or the nature of the performance standards used to evaluate a particular input. One way in which a task is made easier or more difficult is by altering the encoding (e.g., semantics and/or syntax) of the input; another way is by altering the performance standards, e.g., tolerance levels for judging response accuracy. (See Stolurow, 1964b.)

Automation of Instruction

Allocation of functions

In automating instruction, the second step is to determine the way in which the results of the first step (the identification of critical functions to be accomplished by particular materials) are to be implemented by a system of physical components. Some functions may be accomplished by hardware and some by software. The decision to use hardware or software to accomplish a is based upon convenience, economy, or the simple availability of devices. The way in which a particular function is accomplished may have implications for learning which should be given primary consideration. It also is necessary to consider the student's level of development, that is, it is necessary to decide which functions will be performed by the student for himself, and which ones will be automated. In general the decision would be for the machine to perform more functions for the beginning or young student and fewer functions for students of increasing maturity in the area being taught. A deliberate weaning schedule should be built into a series of programs to accomplish this.

R

In order for a machine to be maximally adaptive, it should have three general capabilities. First, it should have the capability of selecting a number of different teaching programs (content and rules for selecting parts of it). Second, it should make decisions on the basis of relevant past performance on educational tasks (to assess entry level), on the basis of ability measures, and on the basis of motivation. Third, it should be capable of changing programs during the course of instruction. As new data are accumulated they should be monitored and evaluated to determine whether the initially selected program or a different program should be used.

Response analysis

The use of a particular means of implementation should follow from a prior analysis of the task in relation to the capabilities of the students to be taught. The first requirement for an automated teaching machine system is that it be response dependent. Consequently, the student's response repertoire is the critical factor in developing the program. The programmer's task is to develop stimulus materials that shape the student's responses and put them under new stimulus control. The student's responses must each determine what will be presented next and/or how it will be displayed. The transformations of student behavior which are to be achieved are accomplished by the so-called auto-instructional program. Consequently, the response antering repertoire; then the instructional objective is defined.

Program

The auto-instructional teaching program consists of two parts. One is the content. The other is the strategy or set of decision rules used in presenting the content.

¶ Content.

The content consists of concepts, information, and instructions which are encoded as units that are expository or interrogative in form, typically small in size, and often called frames. The content is the set of elements upon which the decision rules operate. The encoding is the symbolic form used to present the content to students.

no ¶

MD ¶ The encoding, but not the concepts or skills, can be a dimension of variation in teaching. Unique combinations of content units and decision rules are what determine the difference in self-instructional programs.

Strategy - Decision rules. The decision rules used in presenting content relate to the responses made by the student to expository and/or interrogative frames, the steps of the program. The decision rules are the teaching strategy. They determine the presentation of the content units and other aspects of the instructional experience. There are different sets. One set--the task decision rules--define the task for the learner (Figure 1), since they specify both the input and the corresponding performance standards. In specifying the latter, they also determine the nature of the feedback in terms of knowledge of results or correctness. Furthermore, they specify the sequence in which content is presented.

The decision rules can be thought of as rules for sampling a universe of content at a particular time. In order to individualize this process, the sampling can be based upon specific information about the student. In adaptive systems, content would be one parameter that was response dependent. Another would be the decision rules, and each of these would be based upon different kinds of information about the student. The entry behavior or pretest data would be used to make decisions about the inclusion or exclusion of content. However, characteristics of the responses the student made while he was learning would be used to make selections among decision rules.

The basic problem suggested by this analysis is that of identifying criteria for selecting the decision rules to use in defining a student's learning task at a particular moment during his training. The criteria are not now known, but the procedures for their identification are clear. They consist of studying decision rules as independent variables in research in which learning, retention, and transfer are the dependent variables. In other words, different decision rules need to be used with groups of students who are similar in their aptitudes, their beginning knowledge, and their motivation. Another procedure is to use one set of decision rules with individuals who differ in one characteristic (e.g., their aptitudes), but not in others (e.g., beginning knowledge or motivation). Studies of this kind would reveal the match that is to be sought in choosing decision rules (teaching strategies) to optimize learning, retention, or transfer for individual students who are mastering a specified content.

Still another set of decision rules relates to the control of motivation. These rules relate such factors as evaluation of students' responses to their personality test scores (e.g., Frase, 1963). Changes in the motivation decision rules are based upon rate of response to frames of equivalent difficulty. Increases and decreases from the base response rate suggest motivational waning and waxing which can be adapted to by a shift in evaluative feedback, as well as by changes in task characteristics such as step difficulty, type of example, time of frame exposure, etc.

insert Fig. 2 here

Two stage process

The general procedure and the implications of this approach to automated tutorial instruction are described by Stolurow and Davis (1964). The basic idea is a two stage decision sequence. The first stage consists in making pre-tutorial decisions utilizing available information about the student such as his aptitude, knowledge, and motivation. The second stage consists in making tutorial decisions based upon student performance which is monitored (as new information is produced) while the student learns. In this stage, the decisions are either to continue using the present program or to discontinue using it and change to another program.

The pre-tutorial stage. The outcome of the pre-tutorial decision stage is the identification of a particular teaching program to use with a student. This decision rests upon knowledge about the estimated *time* it takes to achieve a specified *minimum level of mastery* in a particular topic, for students of known aptitude and entry level. The objective of a program of instruction is to move a student, whose aptitude and entry levels exceed a specified minimum, from his beginning level of performance in a topic--his entry behavior level--to a new minimum level of proficiency within a specified maximum amount of time.

The decision process In selecting a program can be treated as a two-person game. In doing this, the matrix is made up with the possible entry levels on one coordinate and the teacher's program choices on the other. The outcomes from the use of each program with a particular entry level are the cell entries (see Stolurow and Davis, 1964). Many different patterns of relationships can result from the relationship between these two sets of variables; however, certain general conclusions can be obtained from analyzing the process in this way. For example, if no two outcomes in a column are equal, and if a set of outcomes is selected by the teacher as being desirable, then, at most, there can be one per column and one per row. Therefore, if the table has r rows and c columns, then the number of different outcomes cannot be fewer than r/c, the ratio of rows to columns. Thus, if we assume that the rows represent reliable and valid levels of student performance at the beginning of a program, and if we have a distinct set of teaching programs, then certain things are clear. For example, if only one program is available for all students, then the number of different outcomes will exactly equal the number of different levels of entry behavior, no more and no less. The ratio r/c will equal r, if c is equal to one. Another implication is that it is necessary to use as many different programs as there are different levels of entry behavior if we want all students to achieve the same objective. Only if the number of teaching programs used by the instructor exactly equals the number of different entry levels will the ratio of rows to columns equal one. This is not to say that homogeneity is a necessary or desirable goal, but rather to indicate that if it is desired it can be achieved only if the number of programs equals the numbers of different initial levels of student ability.

Another implication of the analysis is that a teaching machine, to be used by a school system with students who differ widely in entry behavior, must be capable of handling a wide variety of programs. Therefore, if a computer-based system is used it should be a large capacity computer. The other alternative would be to use a battery of simple machines, each equipped with a different linear program (one for each entry behavior level) in order for all students to achieve the same objective. This alternative would require a great deal of individual program development and preparation. The computer-based system, on the other hand, could generate each of a large number of programs, as needed, provided it has stored within it the content units, the different sets of decision rules or strategies, instructions for the use of each of these strategies whenever a particular criterion is reached, plus the content.

Three things may result from the initial search for a program to match a student's characteristics (e.g., aptitude and beginning achievement level as determined by tests). One result is the location of a program that meets the teacher's objectives for that student. The second possible result is that more than one program would be satisfactory, in which case the search for a specific one would continue with the use of additional criteria for selecting the most efficient program. A third possible result is that no program would accomplish the objective as stated for a student. In this case changes must be made in the originally formulated objectives. Some criteria for changing objectives need to be specified. Some possibilities of changes in objectives can be considered to illustrate the process, two of which are presented in Figure 3. In the left panel the pre-tutorial minimums (Min.$_1$) are represented on each dimension by a solid line. The upper right hand quadrant identified in this way locates the students who are unconditionally accepted for training. The right panel contains two additional pairs of minimums. The first pair (Min.$_2$) establishes an additional area of acceptance. Students in that region are accepted with foreknowledge of risk. The second pair (Min.$_3$) establishes another area of acceptance but it contains students who will be given some pre-training to get them to qualify at the Min.$_1$ level of information before they are given a program to study. These are examples of the way in which a computer-based system could be instructed to make decisions about students when they do not meet the standards known to be required to achieve stated objectives. The important point here is that these are decisions involving changes in objectives for these students since they involve the acceptance of different amounts of time, different final levels or different topics (e.g., fewer topics covered).

insert Fig. 3 here

The tutorial stage. In order to accomplish dynamic decision-making while the student is learning, it is necessary to monitor student behavior as it occurs when using the instructional program identified by the pre-tutorial decision process. In other words, two separate processes are involved. One is the teaching process which consists of the use of a decision rule to choose the next content or feedback unit. The other is the program selection process from his or her responses by means of which the computer learns about each student from the student's responses. On the basis of what it learns by monitoring, it makes decisions to either continue the use of one program or to change to another one. When the rules relate to either the content, the strategy, or both, the program would be changed. Decisions to change to another program may be made to increase student motivation, for example, when latencies fall below a specified tolerance level while accuracy of response is maintained. Decisions may be made to change programs to strengthen associations that have weakened, for example, whenever students respond incorrectly to frames to which they previously responded correctly, or, whenever they take much longer to respond, reviews may be provided. If performance on a test given during learning is poorer than expected from a regression equation, then review material might be presented instead of new material. Decisions to change a program by skipping content also are used and can be based upon test scores obtained during the course of learning. For these decisions, prediction equations based upon aptitude and earlier performance on the program might be used. Performance that is better than expected would lead to a decision to drop some content.

Functions performed in implementing a program

Tutorial instruction involves five sets of functions: (1) That something be displayed; (2) that a response be made to displays; (3) that the response be evaluated; (4) that a new display be selected; and (5) that response information be stored. Each of these functions is involved in every instance of tutorial instruction. These functions can be related to Figure 1.

Display. The display is the input to the student and consists of a frame of a program, knowledge of results (with or without evaluative or explanatory information), or a combination of the two. The cue and elicitor functions have to be provided by different parts of the total display, and the knowledge of results (KR) must follow the response. Thus, if a display combines functions, the KR would be for a previous frame rather than for the new one.

Response acquisition. The student's response must be communicated to the machine where it is transformed so that the machine (e.g., a computer) can use it to make an immediate evaluation and store it for making program decisions.

Evaluation. The evaluation function is performed by comparing the student's response with some standard. It may be accomplished automatically by a teaching machine or by the student himself. Both correctness of response and rate may be involved in an evaluation. If a set of individual responses is to be evaluated rapidly so as to encourage the development of either rhythms or response chains, then a computer-based system seems indicated.

Selection. The two critical outcomes of selection are knowledge of results and content units. The basis for selection can be simple, as in most current teaching systems, or it can be complex as in PLATO (Bitzer et al. 1962) or SOCRATES (Stolurow and Davis, 1964). It can be based upon a short response history, such as the last response (Crowder, 1959) or upon a selected set of responses (Stolurow and Davis, 1964). An invariant predetermined selection principle for both the content frames and the statements providing KR is used in preparing linear programs, whereas a variable principle based upon the student's last response is employed in "intrinsic" or branch programs (see Crowder, 1959). A still more variable principle can be used with a computer-based teaching machine system (Stolurow and Davis, 1964); the decision can be based upon a principle that employs student aptitude, knowledge at some point in time, and personality scores (Idiographic programming--Stolurow, 1964). Furthermore, with the computer, these response data may be used selectively with respect to both parts of the content and variations in the form used to present it. For example, the aptitude scores might be used to select content units, interest scores to select examples, and personality scores to select the different statements providing KR (Frase, 1963). A computer can make a different selection for each of these and, for a large number of individual students at a rapid rate, even if a large library of available materials is used. No other system could do this while using all this information about each student's aptitude, personality, and response history. Thus, a computer provides a genuine innovation to instruction by allowing certain educational decisions to be made based upon test data that reliably measure individual differences, rather than judgment or just the last response, which may be unreliable or even invalid.

Research Relating to Individualized Instruction

It is apparent from the brief description of the SOCRATES model of teaching, which is a two-stage decision process, that the requirements for automation are substantial. A computer-based system is needed not only for the required research to improve the decision process, but also for the implementation of those processes once they are specified. The immediate next step is to look at the reports of research for implications in the form of hypotheses relating to the general problem of individualized education.

The concept of interaction

Cronbach and Gleser (1957) have made the case for the use of decision theory in psychological testing. A case also can be made for the use of decision theory in teaching, provided the process is automated (Smallwood, 1962).

A basic set of data for the decision theory approach to instruction is statistical interaction effects between treatments and individual difference measures. In other words, whenever the combined effect of two or more variables cannot be predicted from the main effects, an interaction exists. This type of failure in prediction is evidence of a non-additivity of the main effects. For example, if it were found that program A was better than program B and that students at level H were superior to those at level L, then these would be main effects. It would be expected from data of this kind that the use of program A with both levels of students would produce the best overall results. However, if it were found that program A was better than program B with students at level H, but that the reverse was true for students at level L, then this would be a statistical interaction effect of interest. It also is possible to secure evidence of an interaction effect of this kind with correlational data. For example, if an aptitude test battery were given to students, some of whom were taught with program A and others with program B, then an interaction effect could be revealed; it would be indicated if aptitude scores of students who had program A correlated with test 1 significantly but not with test 2, and the reverse was obtained with students who had program B.

Whenever an interaction effect is observed it means that it is necessary to be selective in using the program with students if we want to optimize a performance outcome. Evidence of interaction effects between ability and method of instruction, or between personality and attitude toward instruction, for example, is important. It indicates that the teacher (either man or machine) must be discriminating in the use of teaching methods if the optimum effect is to be realized from their use. Consequently, the teacher must be a decision maker as well as a reliable implementer of decisions.

Interactions between ability and methods

Ability and immediate KR without PI. If we examine the data pertaining to ability and method of teaching, there are several studies which suggest that the effect of a particular method is not the same for all levels of ability. Early evidence of this was provided by Little (1934) who studied the effects of KR on the performance of college students. Using students of educational psychology, Little compared conventional instruction alone with conventional instruction supplemented by a quick-grading-and-drill machine which provided the students with immediate knowledge of results. His research indicated that the immediate knowledge of results provided by a simple device can contribute more to the learning accomplished by students in the lower half of the ability distribution than to that accomplished by the students in the upper half of the ability distribution. Thus, for learning, it seems more critical for students of lower ability than it is for students of higher ability to have immediate knowledge of results.

Ability and immediate KR with PI. Little's findings with college students are supported by research with children. Porter (1961), for example, had second, fourth, and sixth grade students learn from a linear spelling program and had other comparable students learn the same words from conventional teaching. Those who learned from the programmed instructional material required about a third of the time required by students under conventional instruction to achieve equivalent results. The greatest gains were recorded by students in the lower half of the IQ distribution. On the other hand, under conventional instruction, least gains were made by students in the lower half of the IQ distribution. Thus, with one method--programmed instruction--the lower half of the IQ distribution was benefited most; whereas, with another method--conventional instruction--this was the very group that benefited least.

McNeil (1962) used kindergarten children and taught them elementary reading skills. He found that requiring an oral response was more effective for the children of the lower IQ range than for those of the upper range; furthermore, the boys learned significantly more than the girls from programmed instruction.

In another study, Eigen (1962) used a program to teach the distinction between number and numeral to eighth graders. He found evidence of an interaction between IQ and the method he used ($p < .10$). His three methods consisted of two different programmed textbook formats--horizontal and vertical--and a teaching machine presentation of the same material. The obvious difference between the two book versions of the program was in the physical arrangement of the frames. However, with the horizontal format the student was required to go from page to page as he progressed from step to step, but with the vertical format the student progressed down a page and simply moved a slider to uncover the knowledge of results information and each new step. Therefore, with the vertical format, the feedback occurs somewhat closer in time to the student's response. Since the time interval was shorter with the condition that showed no correlation between ability and performance, this study can be related to that of Little in which the relationship of immediate knowledge of results to rate of learning was studied. While Eigen used the vertical page format which provided more immediate KR and found that performance was relatively independent of IQ and reading level, he also found that performance on the machine and the horizontal format were related to IQ and reading level. Both were significantly related to immediate and delayed post-test performance. The difference in the correlation between IQ and post-test performance was significant at the .05 level. These data are interesting for they, too, indicate that immediate feedback may be a critical factor in learning for low ability students. In other words, when the correlation with IQ drops out, as it did for the vertical format, then the learning situation is compensating for the differences in general ability level among students. These data say that within an as yet unknown range of variation, lower ability students may perform as well as higher ability students provided the lower ability students receive knowledge of results rapidly enough.

Ability and organization of material. Gropper and Lumsdaine (1961a) compared the effectiveness of a programmed television lesson with a conventional television lecture-demonstration using high and low IQ groups of junior high school students. They used physics materials that taught the concept of heat and found that the IQ groups who received the programmed television lesson performed differently from their counterparts who received conventional television lecture-demonstration. The high ability group was greatly benefited by the programmed course, while the low IQ group was not. In fact, on the delayed retention test, while the high IQ group given the programmed course achieved significantly greater scores than its counterpart who saw conventional television, the low IQ group achieved lower scores with the programmed material than its counterpart in ability who saw the less programmed material.

In this study, the more highly programmed instruction was not as effective as the less programmed instruction for low ability students. In another study Reed and Hayman (1962), using tenth grade students and a program on English grammar and usage, found no overall difference between the means of the students who studied with a program and those who studied with conventional methods of instruction. However, the high ability students performed significantly better with a program than they did with conventional instruction. The low ability students, on the other hand, performed significantly better with conventional teaching. These are interesting findings, for it is more typical to obtain results showing that programming benefits the lower portion of the IQ distribution. They are useful data since they suggest that it is possible to design a program that will disproportionately benefit the higher ability students. In this study the subject matter used was physics, a subject typically taught only to the more able student. This suggests that difficulty level of the material may be another factor contributing to the outcome.

Ability and self-direction in programmed learning

Campbell (1963b) and Campbell with ~~and~~ his collaborators (1963) have investigated the effect on learning and retention when the sequence of frames of an auto-instructional program is decided by the student himself. This condition was compared with a linear program. Two mathematics programs were used: one on permutations and combinations; the other on elementary set theory. In the first study under self-direction conditions, the various components of the program were color coded and cross-indexed to each other, but the low ability students were instructed to go through the program in any manner they wished. In the linear condition the three components of the program (text, examples and explanations, and self-tests) "were integrated into a single, orderly, step-by-step sequence and students were required to proceed through the program page-by-page, answering all questions and reading all the material."

No significant effect of the teaching method was found either in achievement or in retention with low ability students. The failure to find better performance under the self-directing condition was attributed primarily to a deeply ingrained habit of linear study methods. Numerical ability was correlated with achievement (.58) in the self-directed condition, whereas in the linear condition the correlation was only .05. The difference was significant.

A second experiment, conducted with high ability students, used pre-training in either self-directed or linear study prior to the study of the experimental program. The self-directed group was markedly superior to the linear group on the pre-training topic itself (combinations and permutattions) and on an immediate post-test of the main program (set theory). On the final post-test, the difference was significant at the .10 level, but all groups were probably approaching a ceiling of amount learned at that time. The self-directed method of study was more effective with students interested in the topic to be studied (set theory), while this relationship was not found with the students in the linear group. Low ability students (first experiment) preferred the linear program, while high ability students (second experiment) liked self-direction better.

Additional experiments compared self-direction with linear programming in the teaching of geography and history. The main purpose of these studies was to determine the kinds of learning situations in which self-direction appears to be appropriate. The results indicate that self-direction is maximally effective in teaching such topics as mathematics, in which problem-solving and transfer of ideas to new situations are required, and the subject matter is highly structured and hierarchically organized.

Silberman et al. (1961), using three groups of seventeen high school students, compared three conditions: (1) fixed or linear sequences in which confirmation procedure was used; (2) self-directed review following fixed sequence in which prompting was used; and (3) self-direction throughout. They found that condition (3) was significantly better than sequence (2) or (1), but no significant difference was found between conditions (1) and (2). It is possible that self-direction is more effective with high ability students than with low ability students. This hypothesis might be tested. The use of self-directed learning with high ability students has been reported by Mager (1961), Mager and McCann (1961), Mager and Clark (1963).

It is not now known what should be done when writing a program to make it facilitate learning for either the low or the high ability groups.

Interactions between motivation and method of instruction

One study that suggests another type of interaction is by Silberman, Coulson, Gunn, and Melaragno (1962). They had high school students from several different schools study two different versions of a linear program on plane geometry. Significant interactions were found when the data for each school were individually analyzed. In one school the overachievers performed better on a rote form of the programs. In a second school, however, the overachievers performed better on the conceptual form of the program and the normal achievers and underachievers performed better on the rote form. These findings suggest that socio-economic factors determining the school attended may account for the differences in the effect of a method of programming. To the extent that socio-economic factors determine a student's expectations and values, those of a particular ability level who come from different socio-economic backgrounds may differ in their perception of what they should learn and the value of learning. These factors could determine students' reactions to rote versus conceptually oriented teaching. A student who was used to following instructions, for example, would be more likely to want to memorize new material than to think about what he is being taught. One would guess that programs, when exported to other cultures, would be reacted to differently for similar reasons.

One possibility is that a student's attitudes or expectations about the conditions that should obtain in a classroom could very well influence the rate at which he learns in a particular classroom atmosphere. A classroom which is highly autocratic could engender reactions which were either interfering or supportive, depending upon the student's expectations. In many societies, and in many portions of American society, an autocratic environment is expected in the classroom. Under these conditions, rote learning tends to be expected, whereas conceptual learning and the behavior associated with the analysis of problems and ideas is discouraged. The latter type of behavior, however, tends to be more developed in a democratic classroom atmosphere where individual students are encouraged to interpret and to respond in unconventional ways to problems and classroom experiences. These speculations regarding the potential interaction of cultural factors with those built into a set of programmed learning materials are suggestive. They provide hypotheses that should be tested to determine their validity.

Aptitude and achievement correlations

Another set of studies gives us some insight into the factors which may explain interactions between ability and method. In one study conducted by Cartwright (1962), an elementary arithmetic program dealing with a set of concepts relating to fractions was used with mentally retarded adolescent students. He compared the performance of two groups. One group studied the material when it was organized according to one principle, while the other group studied the same frames reorganized according to another principle. One sequence of the frames was designed so that a definite pattern of fractions

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would unfold from page to page as the student worked through the program. Here the progression of the natural order of the numbers was used in organizing the material, so that numerators or the denominators of fractions changed systematically from one frame to the next. With the second sequence the pages were reorganized so that the pattern was not readily apparent to the students from the sequence of the numerals. In fact, the material was deliberately reorganized so that this would be much more difficult for the student to see. In spite of their obtaining equivalent learning scores immediately after the completion of the program, the groups under the two sequences earned significantly different mean scores on tests of retention and transfer. It is interesting to note two findings. The first is that the correlations between tests of specific abilities and learning scores were different for the two groups. The second is that the retention and transfer score means were different for the two groups. The group of students who were given the patterned sequence of steps made retention test scores that were significantly higher than those of students who were given the other sequence. The group means show the reverse relationship for the transfer test scores, however.

When we look at the pattern of correlations between ability measures and achievement, we find that the program containing the patterned sequence of steps compensated more for differences in general intellectual ability (or mental age) than it did for more specific relevant aptitudes. This difference in two sequences is revealed by the difference in the magnitude of the correlation under the two sequences. With the nonpatterned step sequence, general ability maintained a significant correlation with immediate post-test performance. On the other hand, the patterned sequence did not compensate for relevant specific abilities as measured by the California Achievement Test. Under this condition, specific abilities showed substantial correlations with achievement test scores. Under the nonpatterned sequence of programmed materials, these specific abilities did not reveal high relationships with post-test performance. These correlations with post-test performance included arithmetic fundamentals, reading comprehension and language.

In another study by Smith (1962) the pattern of correlations among the primary mental ability sub-tasks and performance following both programmed instruction and conventional instruction were investigated. In addition to the primary mental ability sub-tasks, other ability measures also were employed to further map the possible relationships of interest between abilities and performance following a particular method of instruction. This type of analysis was made to obtain an indication of the ability requirements placed upon the student by different methods of instruction. The hypothesis was that different programs provide different educational experiences and can make different demands upon the abilities of the individuals who take those programs. The results from the correlational analyses of Cartwright and of Smith suggest that there are, in fact, very different relationships between ability measures and performance scores following programmed instruction. These studies show that some differences in the sequence of the frames can make a difference in the aptitudes that determine the rank order of the students on the post-test.

In addition to revealing that different aptitudes are required for best performance with a particular program, this approach gives us a way of determining what the particular abilities are that play a significant role in achievement under specific conditions of instruction. This knowledge provides a new purchase on the programming of instructional experiences. It suggests that sequences could be generated to relate to the ability structure of the individual for whom they are intended. In other words, it is suggested that programs could be developed in such a way as to either match the ability patterns of the students who will be studying them or to compensate for relative deficiencies in aptitudes or abilities. A testable hypothesis is that the latter alternative is most appropriate for very young learners, whereas the former is most appropriate to the more mature student.

Cartwright's study (1962) also indicated that significant differences in either transfer or delayed retention can occur as a result of different learning experiences, even though those experiences may not produce differences in scores on a test of the amount learned. His mentally retarded adolescent students learned a significant amount from the fractions program, but the two groups did not differ in their immediate post-programmed learning scores. On the other hand, the two groups did differ significantly from one another in their residual scores (Du Bois, 1962) on retention and transfer items.

Cartwright found that the patterned sequence of frames produced higher average retention scores than did the unpatterned sequence. However, the reverse relationship was true for transfer test scores. Those who studied with the patterned sequence obtained lower mean scores than the students who studied with the other sequence. The patterned sequence seems to contribute to retention, but it does not seem to contribute to transfer. Thus, we see a paradox: a method of educational programming which is good for producing one desirable outcome may not produce another outcome that also is desirable. In this case, the method producing better retention did not also produce better transfer. Thus we are faced with the practical problem of how to program material to maximize both retention and transfer. Obviously, the method which would achieve both of these would be the preferred one. We must look for methods of programming that optimize objectives since more than one desirable outcome often is wanted.

A related point in need of further study is the possibility that this relationship between retention and transfer might not be the one that would obtain for high ability students. In other words, this result reported by Cartwright might be peculiar to retarded or low IQ students. If this hypothesis were to be studied, a design that included groups at different levels of general intelligence ability would be required.

Abilities and school conditions of instruction

The environment in which learning takes place also can be considered a variable that could affect learning. One set of environmental differences of particular interest in this regard are individual and group learning situations. Another set are those relating to sex differences.

Individual and group learning. An experiment by Dick (see Carpenter and Greenhill, 1963a) is interesting in this connection. College students enrolled in a contemporary algebra course were assigned to a program which they studied either individually or in pairs. While the mean scores of the students working under these two conditions were the same, Dick found that verbal ability accounted for more of the variance than did quantitative ability when students worked in pairs. However, the reverse was true when the students worked individually. These data are interesting in that they suggest that differences in the learning environment can determine the specific abilities which the students need in order to achieve success in a learning task. This finding would be very significant if it were to be supported by additional data. For example, the data could suggest ways in which different social structures in the classroom determine which children, in terms of relevant abilities, would learn the most under a given condition. This type of information would permit the selective use of environments for students with different ability patterns and needs. For some students, an individual learning experience would be used to maximize their potential; for others, group learning experiences would be used to do this.

While the method of study variable has no effect on immediate achievement, the students who had worked in pairs were significantly superior to the students who had worked individually on a retention test one year later (Dick, 1963b). This suggests that retention may benefit from overt discussion of different points of the material to be learned, a result which can be partially explained by recalling that overt responses during learning seem to have a positive effect on retention, if not on immediate achievement.

Sex differences. It is possible that sex differences in favor of men in mathematical and mechanical skills, and in favor of women in verbal skills, are more a result of the prevailing conditions in our schools than true sex differences. Prevailing practices in our culture may be such as to produce very different educational subcultures for men and women, making the obtained differences sex-related rather than physiologically determined.

McNeil (1962) conducted a study that is provocative in this connection. He studied 132 kindergarten children, ninety-one of whom were later followed up as first graders and were taught in a conventional manner by a female teacher. Under programmed instruction as kindergarteners these students were taught word recognition and the boys were found to achieve significantly better than the girls. Later, as first graders, under a female teacher in the classroom, the girls performed significantly better than the boys. McNeil's findings suggest that perhaps a female teacher in the early grades fails to adjust herself on her teaching procedure to the traits of the boys, whereas her adjustment is sufficient to meet the needs of the girls. This possibility raises the question of whether or not programmed instruction in the early grades might be more beneficial to boys than to girls. Also the study of programmed instructional methods with very young children might help in developing information that could be given teachers so that they could adapt their behavior more appropriately to boys.

Another possible explanation of these results also might be given consideration. It may be that these results are related to differences in identification; the important factor determining the first grade results may be that the girls are more able to identify with the female teacher than the boys, and consequently they perform better for a woman teacher than the boys do.

Whatever the explanation, McNeil's results are of considerable interest. They tend to take on greater significance when related to the well-established information that girls tend to perform somewhat better in the early grades than the boys. This sex difference in student learning may be related to either the method of teaching or the presence of female teachers in the classroom or both. Programmed instruction provides a neutral set of conditions in this regard, as machines are not of either sex. This may be an advantage in getting the boys to perform at higher levels of achievement than they do now with female teachers.

Effects of learning conditions

Most of the research on programmed instruction has been concerned with the study of conditions that obtain during learning. These variations in the learning environment can be considered in relation to the model of the instructional system. In doing this, the stimulus, response, and feedback conditions provide the rubrics.

Stimulus conditions. The stimulus conditions during learning can vary in a number of ways. One way is to use a branching procedure so that students see different frames depending upon their responses to previous frames.

When used as a programming procedure, branching has been called intrinsic programming (Crowder, 1959). It is a means by which the stimulus sequence as seen by a student becomes response-dependent just as is knowledge of results.

Another name for the branching type of program in which students who respond differently are exposed to different materials is "bypassing." Campbell (1962) studied the effect of bypassing with grade school children using a program on the United Nations. He found that for students who scored above the fifthieth percentile on the DAT numerical task, the bypass treatment resulted in significantly better performance. In other words, for students of higher ability, a branching type of program is more efficient than a linear type. On the other hand, for students of lower ability both forms of the program work equally well, but neither form worked as well for them as it did for the higher ability students.

Campbell also found significant interaction effects between grade level and method of teaching, and between grade level and the ability of the students. When the grade level considered was four through eight, both of these interactions appeared. Campbell suggested that bypassing is most useful when the topic has a hierarchical structure, making it easier if one learns one step before learning the next higher step. Thus, we see the need to consider the characteristics of the task in making decisions about the method of instruction that will be used. The hierarchical structure is probably related to grade level since with advancing grades one would expect students to have certain prerequisite information and knowledge which would help in the learning of subsequent material.

In general, comparisons of branching and linear programs have failed to control factors that are critical to the comparison. Consequently, there is little that can be concluded from the studies. Beane (1962) found that his branching program was equal in terms of student achievement to a linear one which he also wrote. However, when time also was considered, he found that the branching program was more efficient, since groups of students took less time with it to achieve the same average test score.

Roe (1962) found equivalent levels of learning with linear and branching programs but found forward branching more effective than backward branching. This is interesting in relation to two things. One is that backward branching is more common in "intrinsic programming" (Crowder, 1959). The other is that forward branching permits the student who knows the material being taught to finish sooner. It would seem therefore that Roe's results might not be generalizable without qualification. The qualification would depend upon the difficulty level of the program (e.g., the size of step). If the program were written for high ability students rather than low ability students then remedial branches would seem to be more likely to pay off.

The so-called logic of a program is often considered its main strength. While it has been shown that item sequence can determine differences in the abilities of students who do well on the program, mean differences have not been the rule. The stimulus sequence typically is one for which the logic is not immediately apparent to the learner, nor is it one which if known would give a particular advantage. This conclusion is supported by Zuckerman, Marshall, and Groesberg (1961), Gavurin and Donahue (1961) and Roe (1962). On the other hand, Cartwright (1962) used fractions, and the frames were sequenced under the patterned version of the program so that the natural order of the numbers was used. While no immediate achievement differences resulted, he did find that this stimulus sequence had a memory advantage over that of a mixed sequence. Gavurin and Donahue (1961), on the other hand, did not find a retention advantage for the logically ordered sequence of their materials.

Prompting and confirmation conditions represent another issue relating to the preparation of materials in the development of a programmed learning task. Prompts are stimulus supports or eliciting stimuli. They precede responses. Confirmation stimuli follow response and confirm it.

Angell and Lumsdaine (1961a, b) in a study using eleventh and twelfth graders who were learning an airline code for cities dichotomized the materials into easy and difficult items. These investigators found that the "partial cuing" procedure (a prompting condition) was more effective for slow learners who were learning difficult items. On the other hand, their partial cueing procedure was less effective for fast learners who were learning easy items ($p<.10$). By partial cueing is meant that the students could, whenever they wanted, see one, two, or three of the letters comprising the three-letter code symbol which was to be learned. In other words, the students could see the prompts for correct response if they wanted to and the slow learners were helped in learning difficult items when they used these prompts. However, the fast learners who used the prompts were hindered in learning easy items. Thus, it would seem to follow that slow learners should be allowed to have access to materials that support or prompt their responses when they are learning difficult items. On the other hand, these data suggest that fast learners should not be given this opportunity for they are likely to use it with easy items and in doing so they will be hindered in their rate of learning.

In another study, Angell and Lumsdaine (1961a) compared prompting with confirmation procedures using two different programs in teaching high school students. They found that prompting was more effective than confirmation when partial correction was used--that is, when the student was told that one of two or more responses was correct but not told which was the correct one. On the other hand, prompting and confirmation procedures were equally effective when students were given full correction or, in other words, told specifically which was correct. The full correction procedure, however, was superior to the partial correction procedure provided there were no previous trials using prompting. If the students were given two or more prior prompting trials, then the correction procedures, both partial and full, were equally effective. In other words, the relative effectiveness of a feedback condition relating to the specificity of the correct response is dependent upon the prior learning experience given the students. This suggests that as one technique is used early in a program it should be done after considering the other techniques to be used later on in order to maximize their overall effectiveness. The data indicate that when prompts are used, partial correction should also be used; and that, if prompts are not used, then full correction procedures should be used.

In another study relating to prompting and confirmation, Stolurow and Lippert (1964), building on earlier studies with retarded children, found evidence that their prompting condition was more effective in producing learning than was confirmation procedure when students were taught a sight vocabulary of twenty-five English nouns. However, these mentally retarded students were divided into two groups and one of them was given more practice at the task than the other under each of the two experimental conditions--prompting and confirmation. When a greater amount of practice (overlearning) was given, confirmation was found to produce significantly better retention. In a subsequent study these investigators looked at combinations of prompting followed by confirmation procedures as a way of securing the best effects of both. They found that, in general, retention was best whenever the number of prompting trials was less than the number of confirmation trials. In terms of total number of trials, at all comparable points, this condition ($P < C$) was superior to either the balanced condition ($P = C$) or to the unbalanced condition ($P > C$). The peak of correct recall seemed to occur when the criterion for the confirmation trials was nine, and the prompting fell within the range of one to six.

"Size of step" is a convenient label but an ambiguous reference. It is difficult to specify step size except after the fact by means of percentage of errors. Another less satisfactory definition is in terms of the number of frames in a program, when the content covered is held constant. This is not a very satisfactory definition, however, for, even though it is objective, it is not precise. Rewriting a program to either increase or decrease the number of frames is no guarantee that the size of step is varied if step size is considered as a "cognitive leap." Redundancy might be a more valid description of the variable manipulated. Evans, Glaser and Homme (1962) found that the smaller step programs (fifty-one and sixty-eight steps, respectively) resulted in fewer errors and superior post-test performance. The group with the smallest step size did not perform best, however, suggesting that there may be an optimum size. If the variable is considered as redundancy rather than step size, then it is not the amount of change in the stimulus, but rather the frequency with which the stimulus is repeated that determined the results. From this point of view the Evans et al. data suggest the hypothesis that there is an optimum amount of redundancy to be sought in a program. Too much redundancy leads to negative motivational factors and too little leads to insufficient practice.

Smith and Moore (1962) found no difference in rates of learning to spell with variations in size of step. However, Shay (1961) obtained a more interesting result: namely, no relation between intelligence and step size. Since the problem is a relational one, it is possible that the step sizes that might make a difference at the ability levels used by Shay were not present in the materials. With the existing data, there is little clear guidance regarding step size. One important need is for an a priori measure of step size that predicts error rate. Possibly measures of stimulus characteristics, such as readability or the number of changes in the stimulus as the student goes from frame to frame, will provide such an index.

Response conditions. There are many response conditions which influence the amount that students will learn. The problem is to determine the nature of critical relationships between the learning task structure and student ability, so that the best response conditions can be used for each student at each point in the program.

Fry (1960) found in teaching the meaning of Spanish words and phrases that the constructed-response group was superior to a multiple-choice group on a constructed-response test. However, the constructed-response group took longer to reach the criterion. Coulson and Silberman (1960) also found that the multiple-choice response group required less time but learned an equal amount. Hough (1962) and Zuckerman, Marshall and Goesbert (1961) found no significant differences relating to these conditions.

Burton and Goldbeck (1962) studied the effect of several factors on learning, using ninth grade students and a program dealing with the characteristics of different animals. Their results did not support Skinner's idea that a constructed response was superior to a multiple-choice response, but they did reveal a significant interaction among learning methods, student aptitude, and the presence or absence of a desired response in the previously elicited repertory of the student. When easy multiple-choice alternatives were used, they produced better learning of common responses by students who had high verbal reasoning aptitudes. However, when difficult multiple-choice alternatives were used, the responses were learned better by students with low verbal reasoning aptitudes. Here we see an indication that the difficulty of material may determine the particular aptitudes that come into play. By altering the difficulty level of the material, it should be possible to vary the requirement for particular aptitudes. Measures of difficulty level may provide a useful approach to the assessment of step size. In general, the data are not very illuminating. They certainly do not provide unambiguous guidance to programmers. Some clarification of what is involved could come from the use of research designs in which ability tests were used along with the experimental treatments. Burton and Goldbeck's study provides an indication that such a design could be useful but that the interactions might be complex. For example, general ability test scores might relate to difficulty, and specific ability test scores to performance under the different response conditions. The type of learning that is attempted might also be a factor. The learning of terminology might be involved in some parts of a program and the learning of concepts or discriminations might be involved in other parts. With each of these different types of learning different abilities may be required of the learner, and the relative effectiveness of the different response modes may change.

Eigen and Margulies (1963) used a program to teach three-letter words which differed in difficulty level. Some of the words required more information to reproduce than others. They had some of the students write their responses and others just "think" the responses they would make. These investigators found that overt responses resulted in better post-test performance with both the intermediate and high difficulty levels; however, this was not true for the words with the low difficulty level. Their data pertained to a topic in programmed instruction long in need of discerning study, namely, the study of overt versus covert response. Also of interest in connection with this issue are studies comparing groups who read a text with those who used a program. Typically in these studies the results have shown that students do not have to make overt responses in order to learn, and, in fact, if they do not make overt responses they make take less time to learn.

The problem with the studies that have been conducted has been in the selection of materials. Typically the materials require the students to make responses which are already well established in their repertories. It would seem that materials which require overt response should be those for which the responses are difficult or novel for the student to make. The Eigen and Margulies data support this position. Their results suggest that it would be most effective to have programs in which students were required to use overt response only at selected times. The use of overt and covert response would depend upon the step that was involved and, in particular, upon its difficulty with respect to the student's existing repertory of responses. Furthermore, to optimize conditions it may be desirable for some frames to elicit overt responses from selected students but not from other students. This might be the case simply because students differ in the availability of these responses. Thus, the program might be selective with respect to known information about each student's repertory.

Goldbeck and Campbell (1962) used a short program that taught thirty-five independent factual items to junior high school students. They compared overt, covert, and straight reading groups, where the last of these three groups saw no blanks in the material they read. Of these response conditions they found a significant interaction between the difficulty of the steps and the mode of response. The overt response group performed below the others on steps of low difficulty, but they performed above the others with steps at an intermediate difficulty level. At the most difficult level, the reading mode of response was best, but not significantly so.

Gropper and Lumsdaine (1961b) using a programmed television lesson sequence, much like a teaching machine program, had some students respond actively and others not. They found that those who did respond actively scored significantly higher than those who did not. This finding suggests that active response makes a difference when the lesson is programmed so that students are very likely to respond correctly and actively. This finding supports those of Eigen and Margulies and of Goldbeck and Campbell. Like these other two studies, it suggests that it is most effective to make selective rather than repeated use of overt response.

Feedback conditions

There are several issues that arise in connection with feedback and programmed learning: the immediacy of the feedback, its consistency, and form.

Immediacy of feedback. One variable of significance to the learning model underpinning programmed instruction is immediacy of feedback. The model assumes that the student needs to know after every response whether he is right or not. The typical way this is accomplished in a program is to explicitly supply the correct answer to him. Still another way in which this can be accomplished is to let the student infer it from the frames of the program. To do this requires search and analysis, in short, more active responding, than if the former procedure is used. However, this latter procedure is risky, for the student may not discover the correct answer to a frame. In short, the best procedure to follow is not clearly indicated by theory. The data from the laboratory, where there is control of other possible sources of knowledge of results information, indicate that feedback should be immediate. In translating the basic concept into practice, the experimental controls are often lacking even when programmed instruction is used. With them, the knowledge of results is likely to be available from the next frame or two because of the redundancy in a low error rate program.

In Lumsdaine (1961), two studies (Michael and Maccoby, 1961; Kanner and Sulzer, 1961) report evidence for the importance of immediate knowledge of results. These data support those of Angell (1949) obtained from the use of a Troyer and Angell punchboard, and of Meyer (1960). However, Evans (1960), Smith (1962), and Feldhusen and Birt (1962), and Jacobs and Kulkarni (1963) found no difference in learning from the comparison of immediate with delayed feedback, or from a comparison of presence with absence of knowledge of results.

Consistency of feedback. Laboratory research using repeated presentation of the same stimulus has shown that different schedules of reinforcement make a difference in learning (Ferster and Skinner, 1958). In programmed instruction, the typical set of materials presents a frame only once, or possibly twice. Consequently, a schedule of reinforcement in programmed learning has very different meaning from the same schedule used with repeated presentations of a stimulus. Two factors that mitigate this difference are the high redundancy in a program and the low error rate of the frames. To the extent that a program approaches the "conversational chaining" condition described by Barlow (1960) it would provide the student with knowledge of results on a subsequent frame, so that explicit knowledge of results would not be necessary or critical. In order for a study of reinforcement schedules in programmed learning to be meaningful, it is necessary to specify the degree of redundancy, the error rate, and the degree of conversational chaining in the program. Glaser and Taber (1961) report Scharf's study of different schedules of reinforcement from which there were no significant differences.

Form.--The feedback provided by a program can vary in form in a variety of ways. It can be positive, negative, informative, or evaluative. Where there are many possible wrong responses, knowledge that the correct response was made is very informative; however, knowledge that the response was wrong only eliminates that alternative, it may not also indicate to the student the correct response. On the other hand, in many programs the student learns the correct response after his first response to the frame, since he is given the correct response so as to permit him to evaluate his own response. Melaragno (1960) used negative reinforcement and found that spacing was important. Massed negative reinforcement significantly depressed learning of logic symbols.

Knowledge of results can be used alone or it can be accompanied by an explanation of why the choice was wrong or right. Bryan and Rigney (1956) found that the college students who were given explanations in addition to knowledge of results achieved higher scores than those who did not. Bryan, Rigney, and Van Horne (1957), however, were unable to determine the type of explanatory material that was most effective. Krumholtz and Bonawitz (1962) found that the confirmatory term embedded in a complete sentence aided students in applying what they learned to new problems.

Frase (1963) used four conditions, three of which contained evaluative statements in the knowledge of results frame, and one was the control group which only received knowledge of results. The experimental groups differed in the feedback given them. One group saw feedback statements that evaluated their wrong responses; another group saw positive statements evaluating their correct responses. A third group saw both negative and positive statements as feedback from wrong and right responses. Using a logic program, Frase found that negative evaluative feedback was more effective than positive in changing student performance. With the negative evaluative statements aggression was positively related to attitude, but unrelated to achievement; intraception was negatively related to speed and efficiency; high deference was related to lower attitude toward the learning experience. Also Frase reported that ". . . aggressive Ss liked the program that 'fought back.'"

Summary

Programmed instruction and teaching machines are a part of the technology of education that is concerned with the individualization of teaching. Today's exemplars of this conception are only beginning to employ the full potential of programmed instruction and teaching machines. The tradition in learning research and in educational practice is to consider individual differences as a necessary nuisance rather than an area of inquiry with specific relevance to the decisions made in teaching. Groups of individuals, rather than single students, are used in instructional research and in teaching because they provide more stable statistical measures or make instruction more economical. The psychological requirements of the students are ignored or, at best, slighted in spite of the fact that they are central to efficient teaching. Currently, a study of individual differences has had its primary application in selection and placement, not in teaching where it is so badly needed. With programmed instruction, it is not only useful but also practical to employ individual-differences information in making educational decisions. In fact, some of the more promising leads from research are the data revealing different patterns of correlation between abilities and achievement under different programmed learning conditions. In brief, programmed instruction and teaching machines are forcing the application of the psychology of individual differences into instructional decision-making.

The implications of a truly individualized instructional program are not entirely clear. However, some guidelines can be provided for the initiation of a research-and-development program toward this end. Programmed instruction and teaching machines are the primary educational technological developments contributing to this end. Consequently an understanding of them as a concept and their implications for a philosophy of education is important in the development of today's educational technology. Furthermore, the analysis of instruction as a

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systems concept can make a specific contribution to the development of the materials and machines that will further the practice of individualized education.

The data relating ability to performance suggest that educational prescriptions are on the horizon. In the not too distant future, some educators will be professionally trained to write educational prescriptions for individuals. With more analytical studies, education should achieve the level of maturity of medicine, so that knowledge about a child's needs permits the writing of an educational prescription to provide learning experiences that meet his specific needs. This analogy with medicine is more than just a metaphor. It implies a different approach to educational research and indicates that such research should concern itself with studies designed to fit a decision-theory model rather than an hypothesis-testing model. However, it also suggests that it will be a while before we can achieve even a modest level of precision in writing educational prescriptions. While the goal is clear, the practicalities of the real world are such that it is unlikely that we will achieve very soon a high level of success in the practice of individualized education. One major obstacle is in the lack of materials which can be used in this way. A large number of educators need to become authors of the materials needed to get the job done. Preparation of materials is a painstaking but rewarding process. The sad fact is that it is being done by so few and is therefore progressing so slowly. This note of pessimism should not serve to discourage efforts to achieve the goal, however, since progress toward it is so important and potentially useful.

The past research in education is best characterized as a search for mean differences in effects produced by a method. This tradition has been perpetuated in the search for the teaching method. Unfortunately, this general research paradigm has probably obscured much educationally significant data. That this might be the case is suggested by preliminary results of programmed learning experiments that

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have revealed some interesting patterns of correlation. In other words it seems likely that teaching methods, or treatments, that were educationally useful, have been rejected simply because their average effects with a group of students were not significantly different from those of some accepted or established method. It is possible that some of these rejected treatments did, in fact, have interesting and useful effects not revealed by a simple comparison of means or variances. For example, two methods may have a different effect on the rank order in which they place a group of students in terms of an achievement test without differing in their mean effects. The data from programmed instruction research indicate that different methods of teaching or conditions of learning can produce, on the one hand, different rank orders of students in terms of their abilities and personalities while, on the other hand, not producing mean differences in the achievement scores of the groups.

Data suggest that an analytical approach to instructional methods or teaching strategies may be useful in untangling the complex interrelated effects that occur but are obscured in a global study that examines only group averages. Analyzing the instructional environment into separate dimensions has provided hypotheses with relevance to associative and cognitive learning as well as to motivation. For example, abilities and aptitudes, as measured by standard tests, seem to be most predictive of the associative and cognitive changes taking place as a result of shifts in the sequence of the content. Thus, the organization of an instructional program can be determined by ability and aptitude test profiles of individual students. On the other hand, personality tests seem to be most predictive of the student's attitudes toward his learning experience as these attitudes develop in response to the kinds of evaluations made of the responses he gives while learning. For example, there are data indicating that aggressive students perform better and prefer a program that fights back, in that it evaluates only their wrong responses.

The existent data also have research design implications. They suggest that it is useful to include in a study of educational treatments, pretests of student aptitude and personality so that correlations can be secured between these individual-differences scores and achievement or attitude scores following treatment.

There are some clear and substantial arguments for the use of computer-based teaching research and even teaching. Several of these were presented along with a description of a working system called SOCRATES. The system is built on an instructional model based upon a decision-theoretic analysis of the sequence of events in selecting a program of instruction for each student. The two-stage process model consists in pretutorial and tutorial decision making. Fundamental to this concept and its implementation is evidence of statistical interactions among relevant variables. The existent research on programmed instruction reveal several potentially useful interactions. Many of these interaction effects involve differences in ability and in instructional procedure that suggest the potential utility of adaptive instructional systems.

The results from research on programmed instruction have not been as clear in their implications as they might be. This may be due in part to poor technology, since concepts derived from theory are not unambiguously translatable into experimental operations. There is a need for critical examination of the implications of the theory that relate to experimental operations. Many that are now accepted rather uncritically because of their established reputation in the research laboratory appear to have a function different from that of the laboratory when used in a classroom context. Operations repeated in the context of a complex instructional sequence such as a program, while possessing objectively and specificity may lack the original validity established in the laboratory.

The research results have not revealed a high positive relationship among all the desired learning outcomes when a specific method of instruction or instructional program is used. Rather, the studies show that a program that produces maximum learning does not also produce maximum retention or transfer. It seems necessary, therefore, to think of optimizing a set of outcomes rather than of maximizing each outcome. This concept also has implications for research and practice. It indicates that we need to know how to combine methods to produce optimal results. The concepts used to guide us in mixing methods in order to optimize a set of learning outcomes need to be formulated.

The outcomes to be optimized are not all cognitive. Some are attitudinal and therefore relate to the learning of motivationally relevant habits, such as the desire to learn.

Thus, while there is great promise, there is also a new set of problems. This is both the hope and the hardship. In order to make programmed instruction successful, there is a greater need for teachers who can program and develop the required materials than there is for equipment systems.

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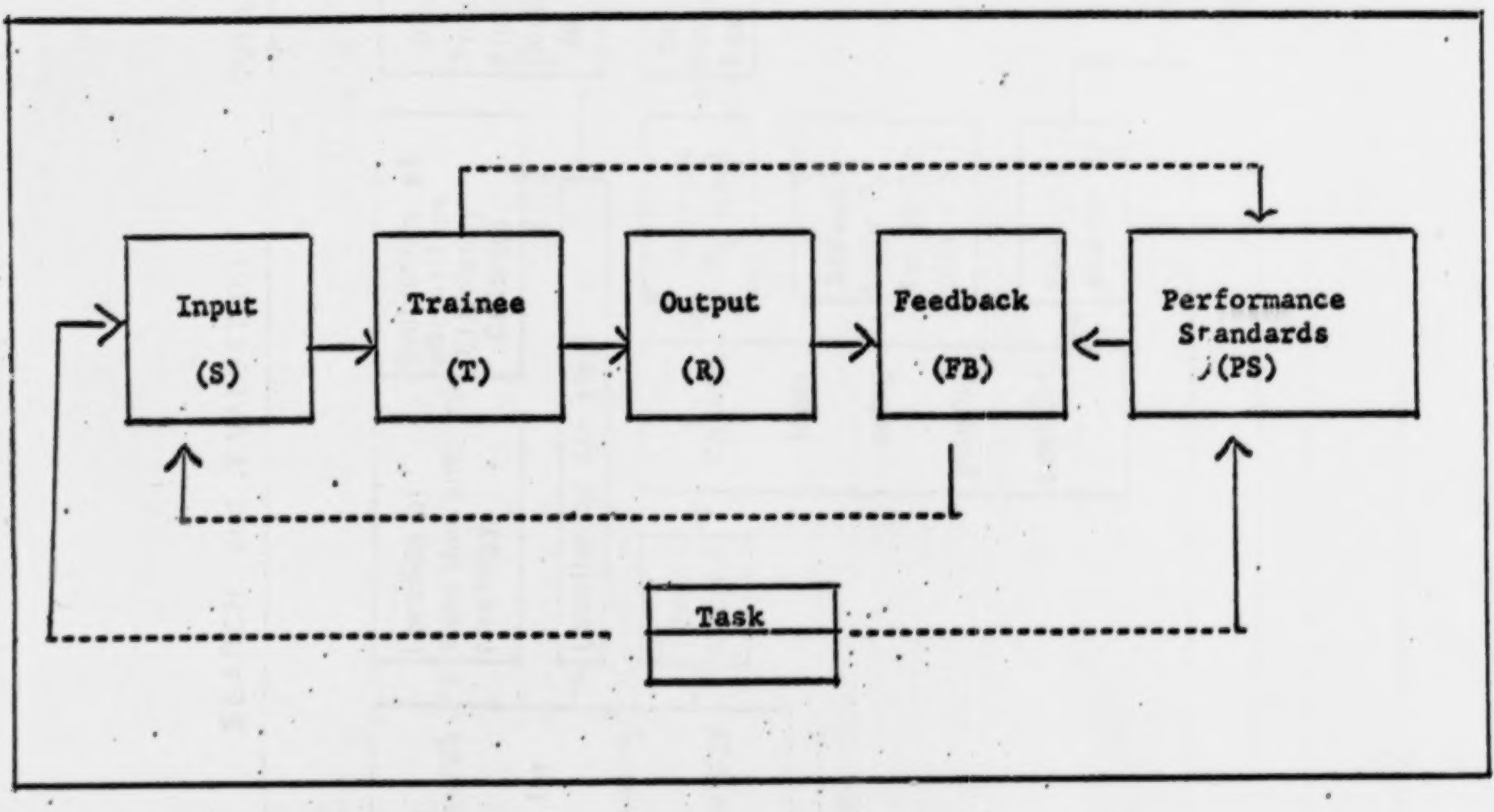
Input
(S)
Trainee
(T)
Output
(R)
Feedback
(FB)
Performance
Standards
(PS)
Task

Figure 1--The Instructional System

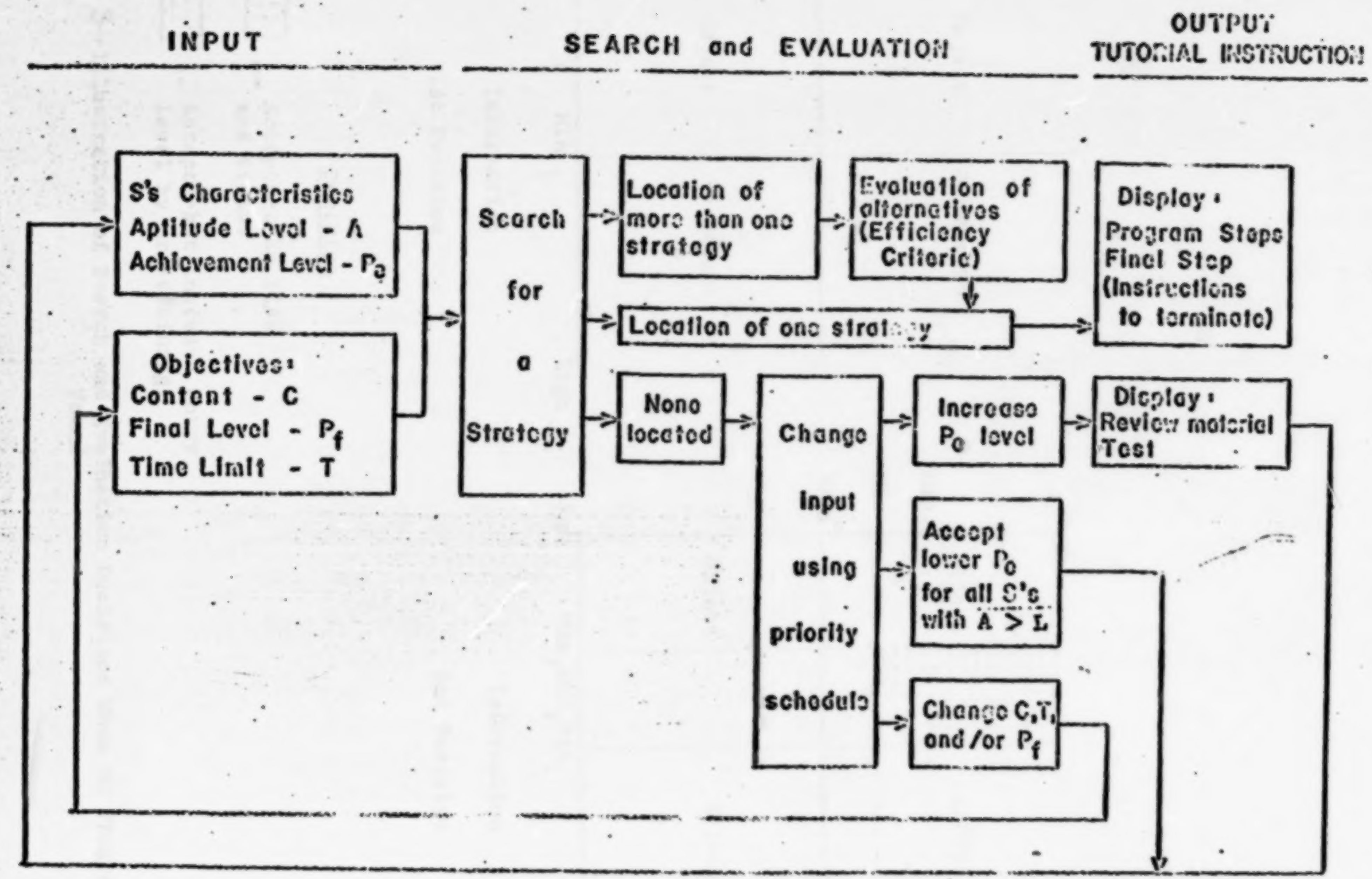
INPUT
SEARCH and EVALUATION
OUTPUT
TUTORIAL INSTRUCTION
S's Characteristics
Aptitude Level - A
Achievement Level - P_a
Objectives:
Content - C
Final Level - P_f
Time Limit - T
Search for a Strategy
Location of more than one strategy
Evaluation of alternatives (Efficiency Criteria)
Location of one strategy
None located
Change Input using priority schedule
Increase P_a level
Accept lower P_a for all S's with A > L
Change C,T, and/or P_f
Display: Program Steps Final Step (Instructions to terminate)
Display: Review material Test

Figure 2. Pretutorial Decision

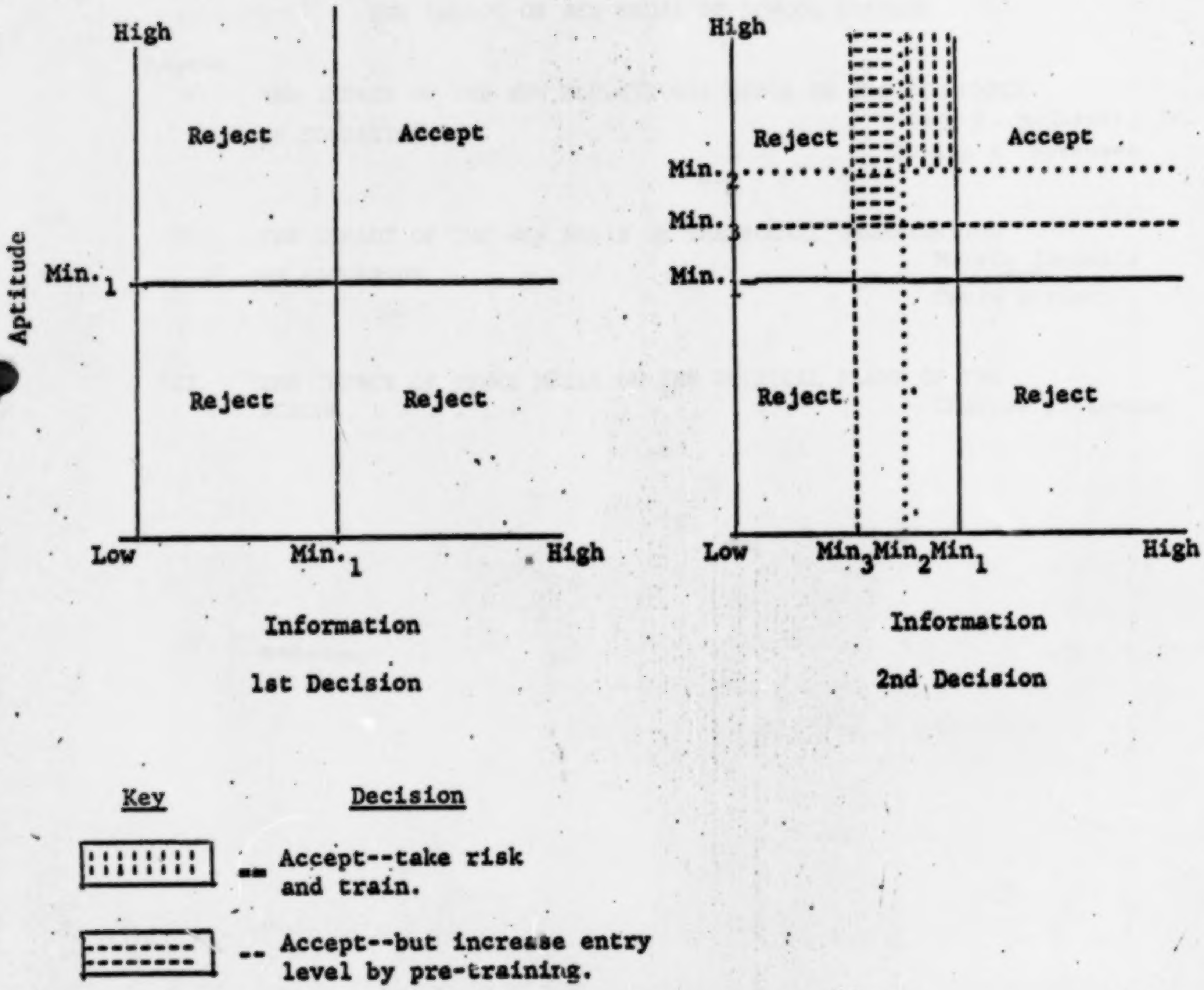
High
Reject
Accept
Aptitude
Min.1
Reject
Reject
Low
Min.1
High
Information
1st Decision
High
Reject
Accept
Min.2
Min.3
Min.1
Reject
Reject
Low
Min3Min2Min1
High
Information
2nd Decision
Key
Decision
-- Accept--take risk and train.
-- Accept--but increase entry level by pre-training.

Figure 3--Illustration of Search and Evaluation Decisions When No Program is Found

PART III

THE IMPACT OF NEW MEDIA ON SCHOOL SYSTEMS

Chapter

V. THE IMPACT OF THE NEW EDUCATIONAL MEDIA ON THE ECONOMICS OF EDUCATION . . . . Henry F. McCusker, Jr. and Philip H Sorensen

VI. THE IMPACT OF THE NEW MEDIA ON THE SOCIAL ORGANIZATION OF EDUCATION . . . . Morris Janowitz and David Street

VII. THE IMPACT OF NEWER MEDIA ON THE PHYSICAL PLANT OF THE SCHOOL . . . . Charles F. Lehman

CHAPTER V

THE IMPACT OF THE NEW EDUCATIONAL MEDIA ON THE ECONOMICS OF EDUCATION

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Introduction

The United States educational system is a huge enterprise. In terms of human and financial resources employed, education is "big business," and thus may properly be viewed as an economic institution. It is, in general, an enterprise that is beset by two major conflicting orientations: a moral commitment to provide quality education for the broad base of the population, and a philosophy of public financing which seeks to provide this education at least possible cost.

The educational system is a labor-intensive enterprise, with quality labor in short supply, relatively expensive, and comparatively unspecialized. It is difficult, therefore, to reconcile education-for-many with education-at-least-cost. "Economizing," in the sense of achieving the best allocation of available resources among competing activities within budget constraints, is, and will be, a vital factor in helping to ease the dilemma by raising the efficiency of the educational system. The new technology of instruction (including new equipment, curriculum organization changes, and re-deployment of staff) may also offer new options and alternatives for confronting the dilemma.

Education as an Economic Enterprise

The magnitude of the United States educational enterprise

The American educational system utilizes huge amounts of economic resources--human, financial, and physical. In rough dimensions, the enterprise encompasses the formal educational system, business and industrial education and training, government and military education and training, self-instruction, and educational programs of religious and community organizations. Some of the available estimates of employment, enrollments, and expenditures in three major sectors of the educational enterprises in 1962-63 and 1969-70 are presented below.

Formal public and private education

Total annual expenditures for formal public and private education currently approximate twenty-five billion. A doubling of this amount may be required by 1969-70 if educational needs are to be met (Freeman, 1958). The total number of students enrolled in formal public and private education is about fifty-three and a half million. This figure includes those persons attending adult education classes and public and private educational institutions (Johnstone, 1963). The student enrollments in this sector of the educational enterprise in 1969-70 will approximate sixty-four million. The number of persons employed in the formal public and private educational system is presently about 3.2 million persons, and is expected to reach 3.8 million at the end of this decade.

Business and industry

The amount spent by United States business and industrial organizations for the education and training of employees has never been accurately determined. Estimated annual expenditures range from six billion dollars (Bushnell and Yoder, 1962) to twelve and a half billion (Mincer, 1962), depending on how education and training are defined and what costs are included. There are approximately five million persons in American business and industry involved in recognized education and training activities annually. Future estimates of the participation of employees in education and training, based on projections of the 1970 labor force (U. S. Bureau of the Census, 1962), indicate that about six million persons will be involved by 1970.

Education and training in the military services and government

A total of approximately 2.4 billion dollars was expended to support federal programs of education in 1959 (U. S. Bureau of the Census, 1962). The Bureau reports that slightly more than three hundred million dollars of this total was spent by the Department of Defense for the service academies, military personnel at civilian institutions, off-duty personnel and dependent children overseas, and research assistantships in educational institutions. Approximately fourteen thousand persons attend the full-time United States service schools (U. S. Bureau of the Census, 1962). Some 480,000 military personnel attend adult education courses while an estimated one million persons in government service, excluding the military, take courses through class attendance, lectures and discussion groups (Johnstone, 1963).

Educational programs of religious and community organizations

This sector of the educational enterprise includes community centers, adult education centers, YMCA's, libraries, museums, churches, synagogues and other related institutions. Approximately 5.5 million persons attend classes, lectures or discussion groups in the aforementioned types of institutions (Johnstone, 1963).

Self-instruction

According to Johnstone (1963), some nine million persons pursue independent studies. Most courses studied without benefit of formal instruction are of the do-it-yourself variety: gardening, technical arts and hobbies, and home improvement skills. A surprisingly high proportion (almost two-thirds) of the foreign language courses taken are studied by means of independent self-instruction.

Although the preceding statistics offer an indication of the magnitude and complexity of the educational enterprise, they do not show the tremendous growth of this enterprise as it has evolved. For example, between 1929 and the present time total enrollments in the formal public and private educational institutions have increased by almost 70 per cent while total population grew about 50 per cent during this same period. Employment in educational services has become the largest single public function in terms of staff size. Adult education has evolved from practically nothing to its present significant place in the education system. Training in business and industry has emerged to become an almost independent educational system itself.

These dramatic increases in educational employment, enrollments, and expenditures are explained in part by such factors as: (1) the rise in births, especially in the postwar period, and the continuing rise in the proportion of young people going on to higher education; (2) the realization, especially during World War II, that investment in training could have a substantial impact on productivity; (3) the necessity for the military services to keep their personnel abreast of the rapidly changing military technology; and (4) the rise in interest of adults with prior education and increased leisure to continue their education on a lifelong basis. The end result of these influences is that annual investment in education now represents a significant portion of United States Gross National Product, approximately 5 per cent if formal education alone is considered, and possibly 7 or 8 per cent if the other sectors of education discussed above are included.

The economic characteristics of the educational enterprise

Three outstanding characteristics of an economic nature are reflected in the United States education system. These are: (1) a high degree of labor intensity; (2) a low degree of specialization of labor; and (3) a low level of research and development activity.

When educational expenditures are examined closely, it is evident that the educational system is an economically "labor-intensive" enterprise. This characteristic of education is illustrated in Table 1 which presents expenditures by public elementary and secondary schools in 1950 and 1960. Although expenditures for only two levels of education are described in Table 1, the pattern is nonetheless representative of the labor-intensive nature of United States education as a whole. The largest single item in the total is "Instruction," with approximately 90 per cent of this amount directed to salaries of the instructional staff. Capital outlay is the second largest expenditure item. However, Clark (1959) and Benson (1961) have shown that very little of this capital outlay is used for equipment and technology of instruction to aid teachers in their work and increase the productivity of the educational enterprise. In contrast to elementary and secondary education, salaries of instructional staff in higher education represent a smaller proportion of total expenditures; nevertheless, teachers in colleges and universities are no more adequately supported by educational technology and equipment than teachers at lower levels of schooling.

The second economic characteristic of the educational enterprise is its low degree of specialization in terms of staff utilization. The Rockefeller Report (1958) emphasized this point, stating that teachers at the primary and secondary levels of schooling are handled as "interchangeable units in the educational assembly line." The report adds, "Perhaps no profession has suffered such a general neglect of specialized abilities as that of the teacher." Clearly, the emphasis in teaching has been on the development of the classroom generalist at a time when other major enterprises have been shifting to a division and specialization of labor. In the lower schools especially, the salary schedule that is generally employed tends to discourage such differentiation of teaching tasks and responsibilities, since it offers no differential monetary reward.

The third important economic characteristic of the educational system is the low level of educational research and development activity. Benson (1961) estimates that local school systems expend approximately twenty million dollars annually on research; this is about 1/200 of what is spent on research by manufacturing firms alone. The reluctance to innovate has prompted a description of education as the last bastion of folk culture in the United States.

Effects of new media on the socio-economic environment of education

Developments in the technology of instruction have prompted reactions ranging from horrified denunciations of inhuman gadgetry to unrestrained proclamations that education's methodological revolution has arrived. The position one takes--indeed, whether one takes a position at all--seems to be affected in part by one's value orientations. The strongest proponents of developments in "hardware-oriented" instructional technology appear to be from among those who are most inclined to view the educational process as amenable to scientific inquiry, and those who seek greater productivity or efficiency--a more "businesslike" approach--in education. Some persons belong to both camps, and each group has such sub-factions as "friends of education," "friendly critics of education," and "critics of education."

Speculation about where the support for or opposition to new media comes from is relevant to questions of the economics of education. Resources to support public education seem unlikely to be available in abundance ever. It is virtually axiomatic that competition for public funds will always exist, and that compromises must be worked out continuously. In part, then, what can and will happen in education may be influenced by the general philosophical viewpoints of those who dominate the formation of public policy and, therefore, influence the kinds of resources available to education. Still, education policy-making (and revenue-raising) is highly decentralized. Even though a decreasing proportion of money for public education comes from local sources, both policy and fiscal control remain primarily local. While it may be possible to develop a sort of "national view" of instructional technology and its place in education, the fact of local control seems to assure that there will continue to be a great deal of variability around any central tendency that can be described.

In the main, we expect the form of the educational enterprise to be only slightly different a decade from now than it is today. Historically, education has been dependent upon personal contact between teacher and pupil--referred to previously as "labor intensity in education"--and we find no reasons for anticipating a radical shift in this pattern. Pupil-to-teacher ratios have decreased somewhat over every period in this century, allowing for a temporary reversal of the trend during the depression years. It appears unlikely that the new media will be viewed generally as means for replacing teachers. The interest in, and publicity about, media innovations in education are such, however, that even traditions as hallowed as the primacy of the "live teacher" have been challenged. The climate for experimentation seems favorable, and media developments have been one of the effective stimuli for this.

Nevertheless, education seems likely to remain massive in size, diverse in form, complex in function, pervasive in effect, and conservative in nature. Pressures of enrollment growth, changes in enrollment composition and characteristics, and demands for curriculum improvement are strong in many places, and these combined pressures may stimulate some striking innovations in educational design. Radical changes, however, seem likely to be the exception rather than the rule. Changes in the structures and functions of education may be accelerated during the coming decade in contrast to earlier periods, but the overall portrait of education in 1975 seems destined to have most of the same distinguishing characteristics as it has today.

Effects of new media on educational research and development

Perhaps one of the strongest reasons for the slow change in educational practices is that very little is invested in conscious efforts to induce change. Education's research and development budget, relative to its total expenditures, is trivial. Much of the research that has occurred can be attributed directly to the search for improved techniques of instruction.

Instructional media have been both a stimulus and a response to educational research and development. Most of the prominent media--television, motion pictures, recording equipment--were first developed for communication rather than education. Their mere existence, coupled with the possibilities of useful applications to educational functions, has stimulated research to test the efficacy of applications, and to guide specialized refinements in the media for instructional uses. One important cycle of educational research, then, has been triggered by the availability of media with potential instructional utility, and the effects of such research have been reflected both in equipment changes and changes in instructional techniques. The media, nevertheless, tended to be conceived and developed initially outside the context of education.

Other new media have had their genesis within an education and training framework; that is, they represent technological responses to perceived instructional needs. Probably the most conspicuous examples are "teaching machines" and simulation devices. Developments such as these have stimulated an unprecedented interest in studies of the instructional process and a flurry of development activity within industries serving, or seeking to serve, the educational market. The two activities, of course, reinforce one another--research findings give rise to modifications in media which, in turn, lead to further tests of performance limits of the media.

Educational process research and media research and development have been generally complementary and mutually stimulating. In the interests of growth of reliable knowledge, product refinement, and educational improvement, this reciprocal interaction seems to hold great promise. Although positive effects appear to outweigh negative ones, at least two negative consequences can grow from the interaction and ought, we think, to be guarded against. The first is the understandable tendency for promising developments to be generalized and accepted too quickly as their advocates overlook the necessary caveats. Something of this sort seems to have occurred with programmed instruction. When hoped-for results are slow to materialize, the net effect may be disenchantment with otherwise promising developments. The disenchantment can cause a withering in research efforts on the part of either potential users or equipment developers. Either effect can work to the detriment of educational innovation.

A second problem of potential significance arises from the prospect of a long lead-time between research and development efforts and the development of marketable products. This prospect may deter many industries with potentially useful contributions to education from attempting to enter the educational products field. Others, attracted initially by the possibility of a profitable market, may stop development efforts before products have been fully tested and refined, but still permit some of these products to reach the marketplace. In still other cases, product development may be started but later abandoned altogether. In any event, the cause of educational improvement is usually ill-served.

These various possibilities lead to the tentative conclusion that education research, particularly as it involves new product development, may need some incentives beyond the normal marketplace to stimulate moderate-to high-risk development ventures. Precedents for research and development subsidies exist in many areas of clearly apparent relevance to national defense; perhaps educational research and development would benefit from similar stimulation.

Whether or not new or added incentives to educational media research and development materialize, we would expect the reciprocal stimulation of media research and educational process research to continue and perhaps even to intensify. The keys to intensified interaction between educational process research and media research and development will be (1) a growing willingness by educational researchers to seek technological solutions to education's problems of low productivity and efficiency and (2) industry's persistence in suggesting educational applications of media development.

Effects of New Media on Educational Practices

Assessing the effects of new media on educational practices presents something of a paradox. For example, certain audio-visual equipment is owned and used by virtually all public schools. The Bureau of Social Science Research (Godfrey, 1962) reports that all but the very smallest public school districts have been able to equip their schools with one or more of four basic items--16 mm. sound projectors, record players, slide-film projectors, and tape recorders. The more recently developed media are apparently not so widely distributed, and ownership is concentrated in limited quantity in the larger districts--often only one or two per district. Nevertheless, the supply of overhead projectors, language laboratories, and television sets has increased rapidly since 1959 and is expected to increase further as school administrators implement reported plans to buy more of this equipment. Table 2 shows the estimated amount of audio-visual equipment that was in use in the United States public school districts in 1961.

Arguing from similar data supplemented by historical trends in the distribution and ownership of audio-visual equipment, Finn (1962a; 1962b) has prophesied that investment in capital equipment for education is at a "take-off" stage. Crowder is reported as saying that by the mid-1960's most systematic teaching in American schools and colleges will be done by teaching machines and programmed textbooks (Margulies and Eigen, 1962). These proponents of the technological revolution argue that conditions are ripe for growth in capital goods for education, observing that in its three-hundred-year history American education has not had the capital investment comparable to that enjoyed by private industrial, military, and scientific organizations. The following major reasons are usually given for the present, and expected future, interest in the new technology of education:

1. The need to increase the productivity of the education enterprise to meet the especially growing demand for education at all levels;
2. The race with the Soviet Union in economic "growth-manship" and the realization that high quality education and training is a key factor in economic growth;
3. The availability of new teaching innovations that require one or more types of equipment, e.g., teaching machines and other self-instructional devices, television, computers, cartridge-loaded projectors, 8 mm. sound film, and language laboratories.

Estimates of future expenditures for audio-visual equipment of the type found by the Bureau of Social Science Research (see Table 2) support the expectation that the ownership base will continue to expand.

One would infer, from the surveys of present equipment ownership and forecasts of growth in ownership, that these media have had considerable influence on educational practice. But herein lies the paradox. The apparent fact is that, in spite of widespread and growing ownership of at least certain media, the essence of the educational process continues to be the relationship between individual teacher and pupil. Media may be used to supplement the person-to-person teaching process, but (except in rare instances, perhaps) media have not been used to transform the basic nature of the process. In short, the effects of media on educational practice have been superficial and selective, rather than fundamental and pervasive.

The key relationship accounting for this phenomenon appears to be that which binds educational practices (essentially, teacher behavior) to educational research. Teaching behavior seems to be singularly impervious to research findings about improved teaching methods.

The behavior of educational decision-makers who determine expenditures for instructional materials may reflect something of this same reluctance to foment a revolution in instructional methodology. From an analysis of school system expenditure patterns, Sorensen and Kincaid (1962) estimated that only about 2 per cent of all educational expenditures in public elementary and secondary schools have gone to instructional materials and teaching aids during the past decade. If by "technological revolution in education" one means a total or radical change--the renunciation of one pattern and the substitution of another--then shifts must occur first in the thinking which guides these allocation decisions.

Audio-visual equipment is found in considerable quantity throughout the educational enterprise, and the expectation that the quantities will increase undoubtedly will be fulfilled. Nevertheless, we feel justified in characterizing education as labor-intensive and technologically deprived. Thus far, availability of the media has not resulted in a radical transformation in the basic nature of the teaching process. In the forthcoming section, we will consider in some detail certain innovations that the educational planner has the power to induce, thereby forwarding the cause of technological progress--if not technological revolution--in educational procedures.

The Evaluation of Educational Systems

In the preceding section, we described the general contour of the total educational enterprise. Organized education, in its various forms, is sprawling, diverse, and complex. It also tends to be conservative. But the new media represent potentially powerful catalysts for accelerating the evolutionary pattern of educational change. Today, in large part due to this developing technology of instruction, wholly new combinations of people and things can be contrived in the search for "best" solutions to problems of instructional design.

The very fact that so many different combinations are possible accents the importance of developing increasingly rigorous, analytical, and open-minded approaches to the design of instructional systems. We propose that the central economic problem of education, no matter what its form or function, is to assure that scarce resources are distributed within the educational system in ways which maximize the probability that desired educational objectives will be realized. This is not a simple problem.

In this section, we will consider problems of system design and resource allocation, influenced by the availability of new media of instruction, as they might be approached in a single public school district. We have used the school district as the unit of analysis since it is the basic structural element for planning and conducting public educational functions--a legal entity and governmental body controlled by a board of elected peers and supported by public funds.

Major variables of the system

The school is a purposive social institution which performs certain formal functions of education. Its primary task is to bring about certain desired changes in the behavior of its students. To do this, the school:

1. Postulates or accepts certain goals as desirable;
2. Performs certain functions intended to achieve these ends;
3. Evolves an organization and procedures to perform these functions;
4. Allocates various shares of its human, material, and financial resources to these functional and structural elements in pursuit of its educational goals.

These, then, constitute the broad classes of variables that may be manipulated in pursuit of educational effectiveness. The measure of educational effectiveness is found in the degree to which general and specific educational objectives are realized. The elements of the system may be arranged in various ways to influence the efficiency with which goals are achieved, and resources may be allocated in various proportions to these functional and structural elements. Media of instruction are of particular importance for they extend the range of options available to the educational planner in devising improved means for performing the functions of education, and thereby enlarge the task he faces in determining how best to allocate his resources.

In the search for new and better ways to perform educational functions and fulfill educational objectives, the planner must accommodate to a number of conditions that are, for practical purposes, essentially unchangeable--the number of pupils to be served, the number of buildings to operate, the general content and objectives of the curriculum, interest which must be paid on debts incurred, and (for any one year, at least) the total amount of money available. Other ingredients, while variable in principle, may be very difficult to modify, due to the force of tradition and custom. Probably the most significant of these is the "pupil-to-teacher" ratio, reinforced by the widely-held conviction that small-sized classes are a "good thing." Thus, while the number of classroom teachers in a system can be varied, the limits within which the number is permitted to vary is normally limited at the top by some idea of what constitutes an acceptable maximum class size.

Our basic thesis regarding the structure of an educational system, the allocation of resources to its elements, and evaluation of the system's performance is as follows:

1. An educational system may be designed in many different ways. Custom and tradition inhibit somewhat the number of acceptable designs, but the range of options, even so, is very large.
2. For each system design, there are associated benefits and costs. By benefits we mean the aggregate of all intended consequences of the system's functioning--student achievement, service to the community, staff growth, and morale; in short, all those objectives which the school seeks to achieve. By costs we mean the price of achieving these objectives--man-hours expended, materials and supplies consumed, or simply the dollar value of the total energy required to operate the system.

3. Rational decisions about optimum system designs call for an assessment of system payoff. To make such an assessment, both benefits and costs must be known (or, more realistically, estimated as closely as possible). That system design is best which promises to produce the most favorable relationship between benefits and costs.

The problem of evaluating alternative system designs against criteria of benefits and costs is illustrated in Figure 1. The vertical axis in the figure represents some appropriate overall measure of system output, such as student achievement.[1] The horizontal axis represents the cost of system operation. In the illustration, Design A fails to satisfy the desired performance criterion, although it falls well within the limit of acceptable cost. At the other extreme, Design D more than satisfies the performance criterion, but falls beyond the acceptable cost limit. Both Designs B and C are "acceptable"--the performance output of each exceeds the minimum desired level and the cost of each is below the maximum acceptable limit. In the case of Design B versus Design C, the educational decision-maker must now decide whether the added increment of benefit from Design C over Design B is worth the increment of cost of C over B.

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[1] Admittedly, the problem of deriving a multi-dimensional measure of overall performance of an educational system may defy solution. It may be necessary to consider total system, or perhaps sub-system, performance against a number of subordinate criteria which have been ordered according to their relative importance. The concept of "sub-system" is, in itself, a difficult one with which to deal. For example, a sub-system might consist of those portions of the total system that are concerned with particular sequences of the curriculum, such as mathematics from the primary through the secondary grade level. Alternatively, it might be more appropriate to conceive of a sub-system as embracing all curricula (mathematics, social studies, sciences, etc.) within an educational level, such as the elementary grades. Clearly, the key to the full use of the decision model is the ability to develop adequately valid and reliable measures of system benefit and cost. Of the two sets of measures, those of system benefit appear to be far and away the most difficult to derive. The problem of unitary cost measures seems more susceptible to solution since the major elements of cost--manpower, time, supplies, equipment, physical facilities, etc.--can be expressed ultimately in dollars. In the case of benefit measures, however, one may have to deal with a variety of different--and perhaps even conflicting--criteria derived from statements of educational objectives.

In the balance of this section, we will consider (under conditions which have been simplified for illustration) the process of selection from system design alternatives as it might be followed in a single public school district.

Some effects of alternative allocations of resources

To illustrate the allocation decisions faced by the educational planner (for example, the superintendent and his staff in a public school district), we will consider some of the alternatives available in a public school district. We have imagined a comprehensive public school system in a community of some 20,000 persons. This school district enrolls 5,200 pupils, in grades kindergarten through twelve, who are housed in eight elementary schools, two junior high schools and one senior high school. Its current annual budget of two and a half million dollars is presented in Table 3.[2]

The budget in Table 3 reflects the extent to which current public school programs are labor-intensive; note that some 80 per cent of total annual expenditures is for salaries. Of this amount, three-fourths is designated for salaries of professional instructional personnel--classroom teachers, principals, supervisors, librarians, counselors, and the like.

In our exercise, we examined the effects of varying selected system characteristics while certain others were held constant. Specifically, we varied the following:

1. The average annual salaries of both professional and sub-professional personnel,
2. The ratio of professional to sub-professional personnel,

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[2] We do not pretend that this is a statistically typical budget for a district of the size and characteristics that we have assumed, but we consider it a reasonable one. It approximates the current United States mode and serves our purposes of illustration. We borrowed it, with some modification, from a specific public school district. The major difference between this hypothetical budget and the aggregate values shown in Table 3 is in the amount designated for capital outlay. Many districts, particularly those in faster-growing communities, have had to spend more on school buildings to stay ahead of enrollment increases.

3. The fraction of the instructional budget to allocate to salaries or, conversely, to supplies and materials.

The following were held constant:

1. The total annual budget,
2. The portion of the total annual budget for instruction,
3. The number of pupils in the system.

The precise values assumed for the illustrative analysis are summarized in Table 4. From the assumptions shown in Table 4, we calculated (1) the numbers of professional and sub-professional personnel who could be employed within the budgetary constraints, and (2) the ratios of students to staff that would then obtain for each staff size under a constant total enrollment of 5,200 students.

A number of intriguing things emerged from an analysis of these data. First, of course, the obvious was confirmed--the educational planner cannot simultaneously raise staff salaries, decrease class sizes, and increase his expenditures for instructional supplies and materials. The data do suggest, however, that the educational planner may have considerably more latitude for varying resource allocations than he might realize. Figures 2 and 3 illustrate relationships of particular interest.[3]

Figure 2 depicts the general relationship between (1) staff composition (the ratio of professional to sub-professional staff) and (2) class size (the ratio of students to staff). Curve I shows what the ratios of students to professional staff in our hypothetical system would be if (1) 60 per cent of the instructional budget were allocated to salaries and (2) professional staff salaries averaged twelve thousand dollars per year and sub-professional staff salaries averaged five thousand dollars per year. Its companion curve (IA) shows the ratio of students to total staff (i.e., combined professional and sub-professional) under similar conditions of budget allocation and salary level.

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[3] In both Figures 2 and 3, the student-to-staff ratio is shown on the vertical axis. This is not meant to imply a commitment to class size as a criterion. The figures simply show relationships between two variables (either or both of which might be part of a multiple criterion) when certain other variables are held constant.

The lower pair of curves more nearly denotes the current state of budget allocations for staff salaries and average salary levels in United States public school systems. Curve II shows the ratios of students to professional staff when (1) 90 per cent of the budget is designated for staff salaries and (2) salary levels average six thousand dollars for professional staff and thirty-five hundred dollars for sub-professional and clerical staff. Curve IIA shows the ratios of students to total staff for these same salary levels and budget allocations.[4]

The most important implications to be drawn from the relationships in Figure 2 appear to be the following:

1. For any given budget allocation or salary pattern, the number of sub-professional or ancillary staff may be increased considerably without exerting radical influences upon the overall ratio of students to staff. In the illustrations shown in Figure 2, shifts from a ratio of 7:1 to as low as 3.5:1 or 4:1 result in only slight increases in overall student-to-staff ratios.
2. If one conceives of sub-professional staff as including educational technicians and auxiliary specialists who assist directly in instructional functions and, therefore, may be properly considered part of the instructional staff, then more favorable student-to-staff ratios can be obtained by increasing the number of ancillary personnel in relation to professional staff. (This possibility seems to be a reasonable one, considering precedents in other professions. For example, increased use of equipment for diagnosis and treatment in the healing arts has led to both greater diversification and specialization

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[4] Other curves generated from the assumed values summarized in Table 4 have not been plotted, but would display the same general shape as those shown in Figure 2. For any given enrollment, the location of a curve with respect to the vertical axis would depend upon the size of the professional and sub-professional instructional staff. The upper limits on the number of staff are determined by (1) the proportion of the instructional budget allocated to professional and sub-professional instructional staff salaries, and (2) the salary structure itself.

Put this section to align with item 2 on p. 243

among physicians and dentists, and to the emergence of multi-leveled and multi-skilled cadres of ancillary aides and technicians.) Perhaps acceptably small class sizes can be maintained while (a) increasing the level of professional staff salaries and (b) increasing the amount of money available for materials and equipment--the capital goods--of instruction.

Figure 3 shows the general relationship between budget allocations for staff salaries and the student-to-staff ratio. This relationship is of particular interest for it suggests an existing source of funds for the capital goods of instruction. The budget for our hypothetical school system showed that about 25 per cent of total annual expenditures was for the fixed costs of system management and housekeeping, and that about 75 per cent of the total budget was allocated to salaries and materials for instruction. Only about 10 per cent of the instructional portion of the total budget was allocated to the acquisition of supplies and materials of instruction. From whence, then, can additional funds for instructional materials come? The total budget, of course, might be increased, provided that the public would accept an added tax burden for support of the schools. Barring this, are there funds that might be used for new instructional materials if shifts were made within the limits of the existing budget? Figure 3 suggests that this possibility is a realistic one.

Three of the many pairs of curves generated from the assumptions presented in Table 4 have been plotted in Figure 3. As the curves in Figure 3 illustrate, the student-to-staff ratio is sensitive to both (1) the total funds available for salaries and (2) the salary structure itself. As in the preceding example (Figure 2), the ratio is also most responsive to staff size.

Curve I represents the upper limit within the restrictions of the assumptions made; this is the curve for student-to-professional staff ratio under conditions of (1) a 1:1 ratio of professional staff to sub-professional staff, and (2) a salary structure which provides for an average professional salary of twelve thousand dollars and an average sub-professional salary of five thousand dollars. Its companion curve is labelled IA and clearly shows the reduction in student-to-staff ratio when professional and sub-professional staff are combined to form the denominator.

Curves II and IIA, which occupy mid-positions in Figure 3, show the student-to-professional staff ratio (Curve II) and student-to-total staff ratio (Curve IIA) for intermediate values of staff composition and salary levels. For Curves II and IIA, the ratio of professional to sub-professional staff is 3.5:1, and the average salaries are nine thousand and five thousand dollars, respectively.

Curve III represents the lower limit for the student-to-professional staff ratio within the range of assumptions in Table 4. This is the curve for a professional-to-sub-professional staff ratio of 7:1 with salary averages at six thousand dollars and thirty-five hundred dollars, respectively. Its companion curve (IIIA) shows the student-to-staff ratio for combined professional and sub-professional staff.

The nonlinearity of the curves shown in Figure 3 suggests that reasonably low student-to-staff ratios can be maintained even under budget and salary conditions that provide for substantial increases in (1) funds for the supplies and materials of instruction, and (2) personnel salaries. For example, perhaps 30 to 40 per cent of the instructional budget could be allocated for the capital goods of instruction, and present professional and sub-professional salaries increased substantially, while still maintaining a student-to-staff ratio that appears reasonable. We will now illustrate some of these options with specific examples.

Resource allocations reconsidered

Of the total expenditures by our hypothetical school system, some three-fourths were designated for instructional functions. Only about 10 per cent of this fraction, however, was allocated for the capital goods and supplies of instruction. If a school system seriously wishes to extend its use of instructional media and test their efficacy, new funds must be found, either through different allocations of existing budgets, or from increased total budgets.

Educational planners who are innovation-minded probably cannot expect large-scale increases in total funds to support the acquisition of and experimentation with new media and techniques of instruction. Undoubtedly school budgets will increase somewhat more rapidly than enrollments, but there are many competing demands for these funds. We believe, therefore, that the educational planner who wants to accelerate his search for better answers to the question of what constitutes the properties of an optimum educational mechanism must find most of his needed new resources from within the limits of traditional levels of support.

Our examination of the hypothetical school system has suggested that considerable flexibility in design and resource allocation is possible without paying an intolerable price in such sacred criteria of quality as student-to-staff ratios or professional staff salaries. To illustrate, let's return to the problems of our hypothetical district. We'll assume the same set of limiting conditions: (1) a total enrollment of fifty two hundred students, (2) a total annual budget of two million five hundred thousand dollars, and (3) an instructional function budget of one million eight hundred and seventy-five thousand dollars for salaries and instructional materials. In view of the relationships summarized in Figures 2 and 3, how might the instructional portion--the one million eight hundred and seventy-five thousand dollars in our example--of the budget be allocated to salaries and materials? What effects would alternative allocations have upon such variables as the numbers of professional and sub-professional staff, the student-to-staff ratios, and the kinds of capital goods of instruction that might be acquired and used?

Some of the many possible alternatives are shown in Table 5. The combination in column I of Table 5 reflects the traditional budget for our hypothetical school district. It shows a general condition which is not too unlike that of a high proportion of all public school districts in the United States today. Implicit in such an allocation of funds to salaries and the make-up of the instructional staff are the beliefs that (1) a low student-professional staff ratio is desirable, and (2) sub-professional personnel capabilities are limited generally to clerical functions.

Combinations II, III, IV, and V in Table 5 represent increasingly radical departures from conventional allocations and notions about which characteristics are most important to system performance.

Combination II maintains the same total allocations for salaries and for instructional materials, and preserves the same average salary levels as Combination I; it differs from Combination I in the ratio of professional to sub-professional staff. Combination II illustraces the low price one must pay (in student-to-staff ratios) to substantially modify the composition of total staff and thereby provide sub-professional ancillary personnel to facilitate instruction generally and the utilization of instructional media in particular. It is often reported (although we don't know how far to press the generalization) that many schools and school systems possess a reasonably generous supply of certain types of instructional aids--slide and motion picture projectors, film libraries, recordings, models, mock-ups, and so on--but fail to use them in the ways and with the frequency that they might. One cause of under-utilization of available instructional media may be a lack of auxiliary specialists to help prepare special instructional materials, service the equipment, arrange for distribution of equipment, and otherwise facilitate full utilization of available resources. Combination II was included to illustrate one way to provide ancillary personnel at low cost.

Combination III differs from Combination I only in that a substantially larger proportion of the instructional budget is allocated for supplies and materials of instruction. The increase would provide an annual expenditure of $108 rather than $36 per pupil for instructional materials. Nevertheless, the student-to-professional staff ratio remains fairly low, as would be predicted from Figure 3.

Combination IV reintroduces the concept of an expanded instructional role for ancillary personnel, previously discussed in the case of Combination II. In Combination IV, an increase in the number of ancillary personnel is combined with the increase in allocations for materials shown in Combination III. The differences between Combinations III and IV are proportionately identical with those between Combinations I and II. In both comparisons, a substantial increase in the numbers of ancillary instructional staff is achieved without reducing the level of expenditure for instructional materials, and without a drastic increase in the ratio of students to professional staff.

Combination V preserves the staff composition and expenditure allocations shown in Combination IV, and demonstrates the added effect of marked increases in staff salary levels. The overall average salary level is increased by almost 50 per cent, as is the number of students per professional staff member. Despite this increase in the student-to-staff ratio, the pattern in Combination V seems to us to be within reason. Its reasonableness, of course, is dependent upon the extent to which one is willing to accept that (1) increases in staff salaries can be accompanied by more selectivity in personnel hiring and promotion practices to support an expectation of greater staff proficiency, and (2) the ratio of students-to-staff is not necessarily a valid indicator of educational quality.

Earlier in this section (see Figure 1), we discussed a decision model for evaluating alternative system configurations according to their benefits and costs. Combinations I through V shown in Table 5 can be evaluated in these same terms. In this instance the costs of each of the five combinations have been held equal. The key task in evaluating their relative worth is to estimate (through empirical experimentation, if possible) the benefits of each against identical criteria derived from the school system's instructional objectives. Although this is a difficult task, we contend that until such a procedure is carried through the educational planner must rely primarily upon intuition to guide his resource allocation decisions.

The combination that yields the most favorable overall relationships of benefit to cost, we believe, will be one that allocates more than the usual amount of funds to the acquisition and servicing of instructional materials, and provides a cadre of specialized instructional assistants to the professional staff. It may even be a combination which pays its staff substantially more than today's typical teacher receives. The important points, however, are (1) that the possibility of alternative allocations be recognized, and (2) that the alternatives be compared systematically to one another so that the selection of a most promising arrangement can be made analytically and rationally.

Implications of New Media for Educational Planning

Today, wholly new combinations of teachers and media can be contrived in the search for best solutions to problems of instructional design. We suspect that genuine tests of most of the plausible options--particularly those which are media-dominated--are not likely to be made if the choice is left to the classroom teacher. This is a major reason why we have attempted to persuade the educational planner to create conditions which force certain experiments to be carried out in authentic classroom settings.

The problem of a proper balance between investments in instructional personnel and the paraphernalia of instruction is an open question and an under-researched one. Surely the balance will vary somewhat with the instructional objectives to be achieved, the characteristics of the learners whose behavior is to be influenced, and the time and cost constraints within which the instructional process must be carried out. The important point is that analytically rigorous choices among alternatives can be made only as experimentation is carried out to determine the costs and benefits associated with various options.

The allocation examples were intended to demonstrate that the degrees of experimental freedom available to the educational planner may be greater than he realizes, even within existing limits of educational support. More of the instructional budget could be allocated to media and materials of instruction. Professional instructional staff could be augmented by far greater numbers of specialized ancillary personnel, thus leading to new patterns of role relationships and responsibilities within the instructional staff. But until empirical experimentation occurs in an atmosphere which is at once open-minded and tough-minded, and until experimental results are evaluated rigorously and dispassionately, reliable cost-benefit factors will not be developed.

Economic considerations and system-analytic techniques may be useful in determining optimum solutions to problems of instructional practice, but the essential contributions must come from noneconomic sources. The cost-conscious operations researcher may suggest combinations of people and things which deserve consideration in the search for best designs, but the educators and behavioral scientists (aided by the educational philosophers) must plan and conduct the studies which establish reliable estimates of instructional cost and effectiveness.

In summary, we believe that the United States underinvests in education; that it could and should spend more than it now does. We doubt, however, that it soon will. Because of this, we suspect strongly that measurable increases in the overall effectiveness of education will require that the educational process make increasingly intensive and sophisticated use of new instructional technology. Such experimentation, we are convinced, could occur without a marked upward shift in the amount and kinds of available resources. The greatest obstacles to change seem to be the inertia of habit and a generally uncritical acceptance of questionable criteria of educational quality.

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Table 1--Expenditures For Public Elementary and Secondary Schools By Type of Expenditure, 1950 and 1960*

Type of Expenditure	1950		1960	
	Total Dollars	Per cent	Total Dollars	Per cent
Total expenditures . . .	$ 5,837,643	100.0%	$15,613,255	100.0%
Total current expenditures, all schools . .	4,722,888	80.9	12,461,955	79.8
Current expenditures for day schools	4,687,274	80.3	12,329,389	79.0
Administration . . .	220,050	3.8	528,408	3.4
Instruction	3,112,340	53.3	8,350,738	53.5
Plant operation . . .	427,587	7.3	1,085,036	6.9
Plant maintenance . .	214,164	3.7	422,586	2.7
Fixed charges	261,469	4.5	909,323	5.8
Other school services	451,663	7.7	1,033,297	6.6
Other current expenditures	35,614	0.6	132,567	0.8
← Capital outlay . . .	1,014,176	17.4	2,661,786	17.0
← Interest	100,578	1.7	489,514	3.1

do not indent these two

*U. S. Bureau of the Census, Statistical Abstract of the United States: 1962 (Eighty-third edition), Washington, D. C., 1962.

Table 2--Estimated Amount Of Audio-Visual Equipment In U. S. Public School Districts, 1961*

Type of Equipment	Estimated Total Number in Use	Estimated Total Number in Use per School District
Record players	365,000	11.8
Combination slide-filmstrip projectors	136,000	4.4
16 mm. sound projectors	126,000	4.1
Radio receivers	109,000	3.5
Tape recorders	88,000	2.8
Television receivers	50,000	1.6
Opaque projectors	39,000	1.3
Filmstrip (only) projectors	33,000	1.1
Portable public address systems . . .	30,000	1.0
Central sound systems	29,000	0.9
Overhead projectors	14,000	0.5
2x2 slide (only) projectors	6,400	0.2
Language laboratory installations . .	4,600	0.1

*Total numbers of each type of equipment from Godfrey (1962). Estimated numbers per school district calculated separately; calculation assumes 31,000 operating public school districts.

Table 3--Hypothetical Annual Budget For A Public School District Serving 5,200 Pupils In Grades Kindergarten Through Twelve

Function	($ thousands)					
	Personnel Salaries		Supplies, Materials, and Other Uses		Totals	
	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent
Central administration	$ 48.0	1.9%	$ 12.0	0.5%	$ 60.0	2.4%
Instruction						
Professional personnel .	1,500.3	60.0	-	-	1,500.3	60.0
Sub-professional and clerical . .	127.2	5.1	-	-	127.2	5.1
Materials and supplies . .	-	-	187.5	7.5	187.5	7.5
Payroll burden (Insurance, retirement, etc.)	75.0	3.0	-	-	75.0	3.0
Auxiliary services . . .	64.8	2.6	7.5	0.3	72.3	2.9
Plant operation and maintenance	141.7	5.7	122.5	4.9	264.2	10.6
Transportation .	15.0	0.6	10.0	0.4	25.0	1.0
Other (food service, community service, etc.)	5.0	0.2	32.5	1.3	37.5	1.5
Capital outlay .	5.0	0.2	121.0	4.8	126.0	5.0
Debt service . .	-	-	25.0	1.0	25.0	1.0
Total .	$1,982.0	79.3%	$ 517.0	20.7%	$2,500.0	100.0%

Table 4--Assumptions Used In The Resource Allocation Problem

Factors Held Constant	Fixed Values Assumed
1. Total annual budget	1. $2,500,000
2. Funds for instructional functions	2. $1,875,000
3. Number of pupils	3. 5,200

Factors Which Were Varied	Variable Values Assumed
1. Average annual salaries for professional personnel	1(a)$ 6,000 (b)$ 9,000 (c)$ 12,000
2. Average annual salaries for sub-professional and clerical personnel	2(a)$ 3,500 (b)$ 5,000
3. Ratio of professional to sub-professional personnel	3(a) 7:1 (b) 3.5:1 (c) 1:1
4. Per cent of instructional budget allocated to salaries	4(a) 90% ($1,687,500) (b) 60% ($1,125,000) (c) 30% ($ 562,500)

Table 5--Illustrative Instructional Budgets For Hypothetical School District Under Various Combinations of Salary Levels, Staff Composition, and Allocations For Instructional Materials

Factors	Combinations ($ thousands)				
	I	II	III	IV	V
Ratio of professional to sub-professional staff .	7:1	4:1	7:1	4:1	4:1
Per cent of instructional budget for salaries[a] . .	90%	90%	70%	70%	70%
Average annual salary for professional staff[a] . .	$ 6.0	$ 6.0	$ 6.0	$ 6.0	$ 9.0
Average annual salary for sub-professional staff[a].	$ 3.5	$ 3.5	$ 3.5	$ 3.5	$ 5.0
Number of professional staff[b]	260	246	202	191	128
Number of sub-professional staff[c]	37	61	29	48	32
Number of students per professional staff[d] . .	20.0	21.1	25.7	27.2	40.6
Number of students per total staff (Professional plus sub-professional)[d] .	17.5	16.9	22.5	21.8	32.5
Funds available for instructional materials[e]	$ 187.5	$ 187.5	$ 562.5	$ 562.5	$ 562.5
Total instructional budget[a] .	$1,875.0	$1,875.0	$1,875.0	$1.875.0	$1,875.0

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[a] Includes arbitrary share of payroll burden (retirement, insurance, etc.).

[b] Includes classroom teachers, principals, counselors, librarians, supervisors.

[c] Includes all ancillary instructional and clerical staff.

[d] Assumes total district enrollment of 5,200 pupils.

[e] (100 − per cent for salaries) / 100 × Total instructional budget of $1,875,000.

minus

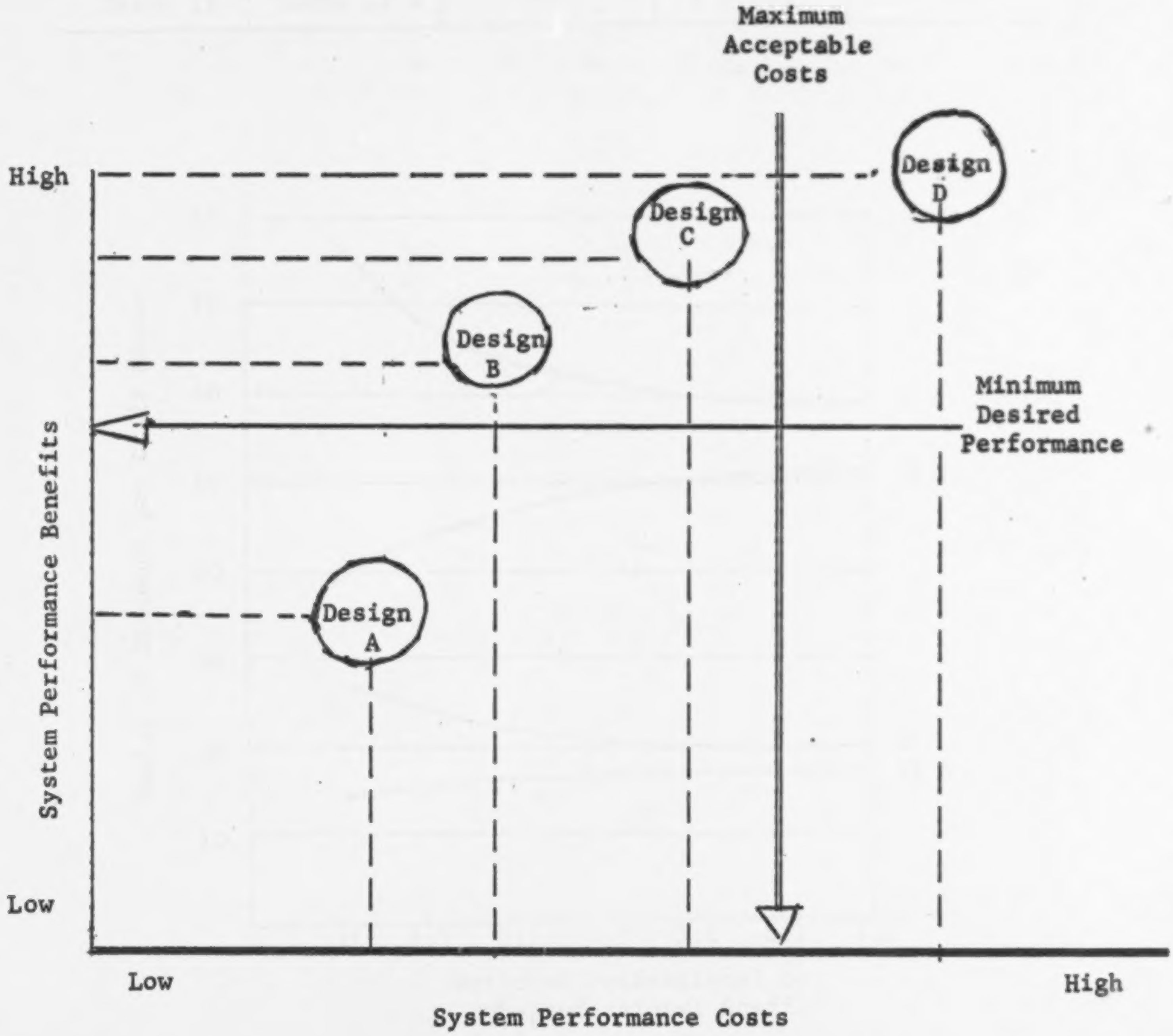

Figure 1--Illustrative Comparison Of Alternative Educational System Or Sub-System Designs Directed Toward Similar Objectives But Differing In Benefits and Costs

Students per Prof. Staff	Students per Total Staff	Per cent of Instructional Budget for All Salaries	Average Annual Salary	
			Professional	Sub-Professional
Curve I	Curve I A	60	$12,000	$5,000
Curve II	Curve II A	90	$ 6,000	$3,500

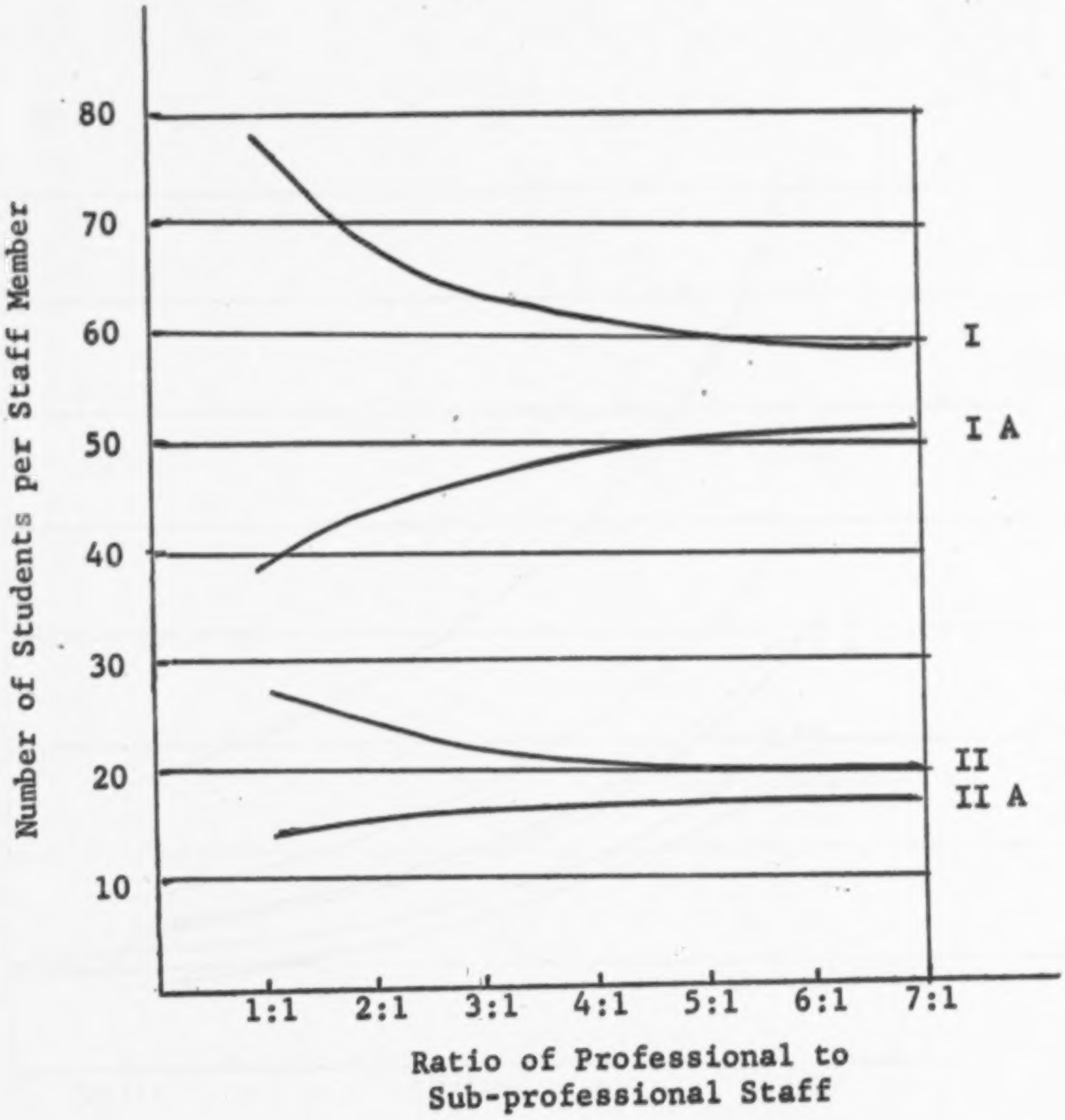

Figure 2--Relationships Between Staff Composition and Student-to-Staff Ratios Under Various Budget and Salary Conditions

Students per Prof. Staff	Students per Total Staff	Ratio of Professional to Sub-Professional Staff	Average Annual Salary	
			Professional	Sub-Professional
Curve I	Curve I A	1:1	$12,000	$5,000
Curve II	Curve II A	3.5:1	$ 9,000	$5,000
Curve III	Curve III A	7:1	$ 6,000	$3,500

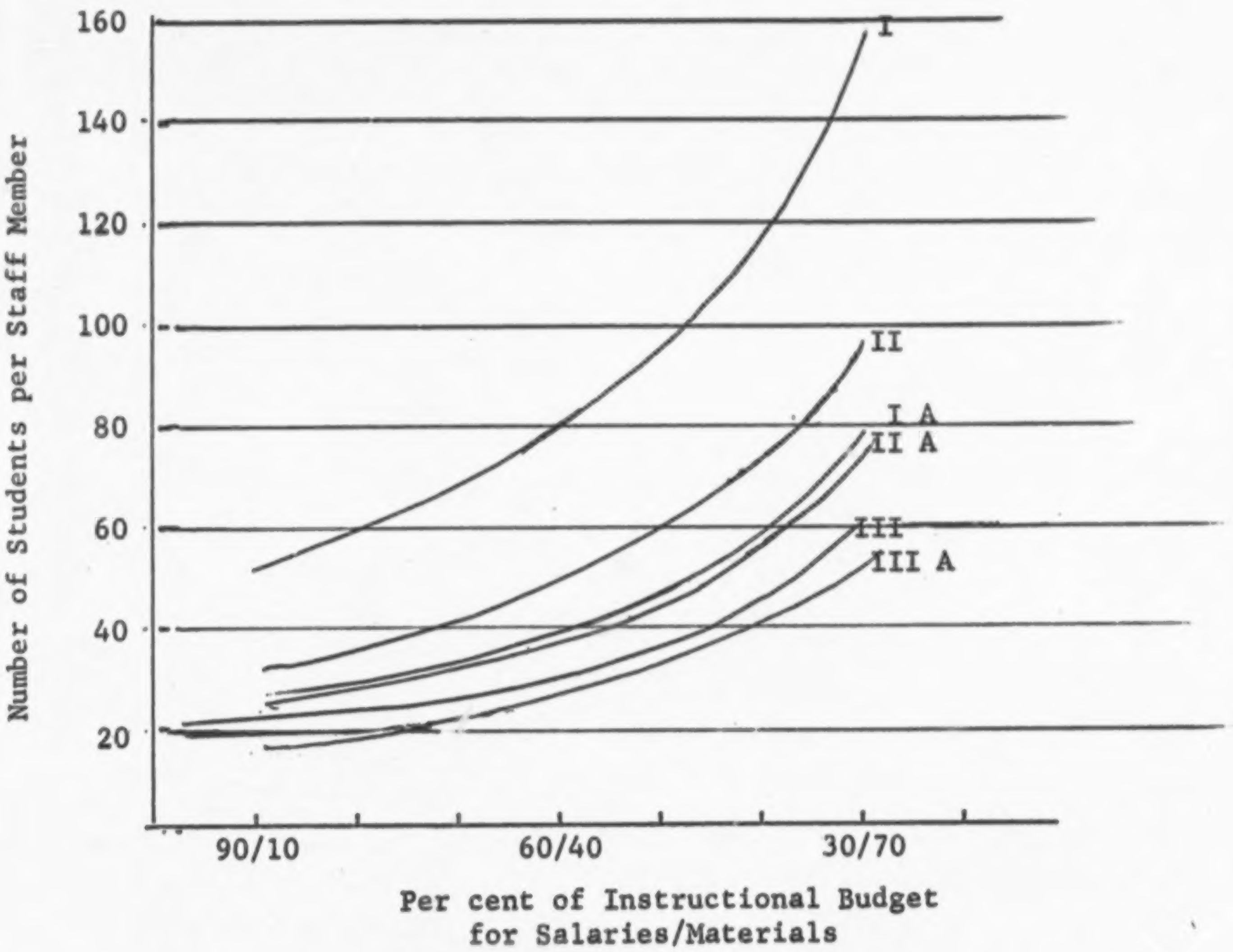

Figure 3--Relationships Between Budget Allocations For Salaries or Materials and Student-To-Staff Ratios Under Various Staff Composition and Salary Conditions

CHAPTER VI

THE IMPACT OF THE NEW MEDIA ON THE SOCIAL ORGANIZATION OF EDUCATION

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Technology and Social Change

It was inevitable that popular and even professional discussion would produce utopian exaggerations about the impact of the new media on mass education. For example, it was predicted that in many fields of study the school would become unnecessary, as students pursued their studies at home by means of the new technology and received their degrees after passing national examinations. Fine (1962) reviews and discusses such predictions. Such an outlook reflects the over-preoccupation of Americans with mechanical devices, which are seen as prime movers of social change. It also reflects a strong tendency in the United States to overestimate the impact of the mass media on social institutions generally.

It also was inevitable that some academic scholars would decry the potential social consequences of the new media for the content and quality of education. For decades students of the "mass society" point of view have claimed that the mass media were debasing modern society. Naturally, they took the view that television, teaching machines, and the like would depersonalize the educational process and would strengthen the "worst" characteristic of American education: superficiality as a result of the effort to reach the largest numbers of students. In their view, use of the new media was tied in with the economic crisis in education, and could operate only so as to speed up this process of deterioration in education (Clark, 1962).

The impact of a series of technological developments, such as the new media, is a complex social process. The purpose of this paper will be to help clarify the actual and potential consequences of the new media for the organization and personnel of the educational system. While we will not seek to minimize these consequences, we will find it necessary to be more observant of the tenacity of social institutions and professions than is usually the case among media specialists. Reports of experiences with these media, the claims of specialists, and the counterclaims of critics need to be scrutinized in the light of organizational theory and reality.

In this paper we shall develop the argument that the educational potentialities of the new media must be assessed not only in terms of their expanding technological capacities for disseminating educational content but also in terms of the sociological context within which these media are to be utilized. We will analyze the ways in which the educational institution adapts to the new media. Further, we shall propose that in the absence of deliberate professional practices for managing the new media more effectively, the introduction of these media is likely to lead to high levels of routinization, impersonalization, and standardization of education. By contrast, we shall contend that appropriate attention to the organizational settings of these communications media could preserve, even enhance, education which is individualizing, conducive to self-respect, and pluralistic--while at the same time achieving some of the benefits, economic and other, claimed for the new media. This analysis will be frankly speculative. Only by risking the use of our fundamental conceptions and available knowledge on today's preliminary trends can we hope to gauge and influence tomorrow's patterns with intelligence.

Delimitation of the "new media"

Our delimitation of the new media is broad enough to encompass the full range of new devices and procedures for mass education. The term, "new media," has come to mean the various forms of television and programmed instruction, as well as a variety of devices such as motion pictures, sound recorders, film strips and the like, which have been in use for many years. At the core of this technological revolution are television and the teaching machines which have dominated public discussion. In addition, we must be as interested in such devices as the unglamorous tape recorder, which has significant potentialities for the teaching of language and reading skills to the culturally deprived youngster. We also include in the new media the other family of technology developments, namely, printed and duplicated texts, to the extent that new technology makes possible less expensive production, greater flexibility and, by implication, greater decentralization of organization and production. The paperback revolution in textbooks already has increased the availability of printed materials dramatically. Moreover, it has the capacity of allowing any major school system to create its own teaching materials.

Mass Communications as a Social Process

To study the impact of the mass media from a sociological point of view, it is necessary to think of communications as a social process, involving a focus on interaction. Interaction encompasses the communicator, the content, the audience, and the situation. For communications to be effective, it is necessary for a back-and-forth interaction, or a two-way flow, to occur. The effective communicator, from this point of view, is alert to feedback: he is ready to modify his message in order to relate to the special needs and requirements of his audience and setting. This is especially important to the teacher, who continually must attempt to impart new ideas, and who always must be aware of the backgrounds and responses of his students and the realities of the educational institution in which he operates.

This focus on social process should be contrasted with that of the stimulus-response approach, which assumes that the stimulus is given or fixed, and seeks to understand specific responses to predetermined messages. This latter approach underlies the experimental design of most of the studies of the impact of the new media and of the mass media generally. While the stimulus-response model has important applications, its limitations must be kept in mind. Criticisms of this approach are as classic as the formulation itself. It does not concern itself with the genesis of the stimulus or the message--a fact of central importance to the student of education. Further, this model assumes a sharp distinction between stimulus and response, although in reality the last response influences the next stimulus, and assumes a one-way pattern of influence when communication is at least two-way, although hardly balanced. Most importantly, the stimulus-response model, and the "rigorous," quantitative before-after research designs which it has spawned are not broad enough to encompass the full range of functions which the media perform, or the social environment in which they operate.

The functions of the new media

For our purposes, we can think of the new media as having three major functions: providing information, socializing, and mobilizing. By the information function, we mean the transmission and dissemination of information and essential knowledge, and the posing of alternatives for economic, social, and political action. By the socialization function, we mean the transmission of a cultural system, and the inculcation of values and norms which make possible a person's participation in a variety of social groupings--from the family to the nation-state. By the mobilization function, we refer to the processes of persuasion and the development of loyalties and attachments which are essential for collective problem-solving.

Research on the effects of educational television, reflecting the narrow stimulus-response model of research design, has fixed almost wholly on the information function, and therefore has grossly ignored the role of this medium in the processes of socialization and mobilization. It is clear from the large number of studies on educational television that, as a means for disseminating certain types of information, this medium does not, in fact, have inherent limitations as compared with ordinary classroom techniques.[1] Thus, since to disseminate certain information content television is no worse than the ordinary teacher, these studies shift the policy issue to one of economy. It is asked: Is television cheaper than classroom teaching? Under some circumstances, it is. There is no reason to assume that television under _all_ circumstances, and for all purposes, is more economical, however.

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[1] For the most recent and comprehensive survey of this research, summarizing about four hundred studies which compare the results of video and classroom teaching, see Schramm, 1962. Also see Ford Foundation and Fund for Advancement of Education, 1961, and Kumata, 1960.

Use of the stimulus-response model to study educational television has, by its very nature, led to a concern with very short-term consequences. However, we need answers to questions about the long-term consequences, such as the impact on student interests, morale, values, and on student social organization, aspects which lie outside the conventional experimental format. Rarely (if ever) is the crucial question asked: What is the impact of television instruction upon the teaching staff, the student body, and the whole organizational capacity of the educational institution? What are the effects on socialization of television instruction? In short: What are the side effects--when the side effects may be more powerful than the direct effects? To answer such questions we need to think of communications as a social process.

Fortunately, the beginnings of a body of research needed to deal adequately with the wide range of consequences of educational television have developed in a separate set of research designs. These designs were efforts at probing the socializing effects of mass television on children viewing in the home (Schramm, Lyle, and Parker, 1961; Himmelweit, Oppenheim, and Vance, 1958). While the research dealing with this problem has not freed itself completely from the stimulus-response model, it has much more fully approximated the requirements for understanding the new media adequately. First, these studies have been concerned not with the reaction to specific programs but with the overall impact of television content. Second, by use of survey techniques, emphasis has been placed upon more long-term trends, especially through the comparison of different age groups. Third, there has been a strong emphasis on probing unconscious reactions and imagery in order to study the modification of underlying values. This research even has involved ingenious work on fantasy in response to the aggressive symbols of television. Fourth, by studying how young people use television, the dynamics of youth subculture have been brought into focus.

From such studies, there is ample evidence that television can have a significant impact on the socialization of young people. For example, there is indication that for some youngsters television can inhibit personal development and the growth of self-esteem. These studies have indicated that all members of the television audience are not uniformly affected, and that the portion of the audience which is strongly influenced is small. As a result of such research, we can derive a broader and more comprehensive understanding of the impact of the new media, in terms not only of its informational aspects but also the associated socializing and mobilizing effects.

The social environment

To assess the impact of the new media, it is necessary to take into account the nature of the social environment provided by the society and by the educational system. In American society, "urbanism as a way of life" has become the dominant feature, as the bulk of the population concentrates in large metropolitan centers. The class stratification system can no longer be described as a pyramid, since most of the population--the great middle majority--are in the middle stratum. Increasingly, the mass media and the educational system must address themselves to the social problems of this middle class majority--problems which derive from affluence, mobility, and middle-class values.

But urbanism as a way of life reflects a deep national dilemma. On the one hand, the last twenty-five years have witnessed an unprecedented rise in economic standards of living. The United States has reduced the proportion of the population living near the poverty line from 60 to 25 per cent. The same period has produced a tremendous expansion of educational facilities so that the percentage of people under nineteen years old enrolled in school continues to grow, and exceeds that of any country in the world. But at the bottom of the social structure, poverty is chronic because of sickness, broken families, mental illness, and ineffective education. These dispossessed groups are not likely to benefit by the rising standards of living.

But perhaps the most profound change in contemporary society is the transformation in expectations, the "revolution of rising expectations." The population insists on increasingly higher standards of living. Minority groups demand social justice as a part of the process of achieving what we might call the "Great Society." The mass media are central in developing these personal expectations. Society seems more and more prepared to acknowledge the justice of these demands, particularly for the elimination of social and ethnic discrimination. Repression gives way to the demand for consensus and mutual toleration.

There is no evidence that crime, mental illness, and deviant behavior have increased markedly in the last half-century. Slums and slum schools, which have always existed in an urban industrial center, enter into the consciousness of society in a dramatic way. At the threshold of affluence and the "Great Society," public opinion demands that these ills be eliminated or at least greatly reduced. In a sense, modern social structure is beset by a deep paradox. The spread of affluence does not decrease social problems; instead, it increases the demand to eliminate the existing social problems.

As a result, considerable attention has been focused on the public school's ability to educate the sons and daughters of the poor, or the culturally deprived, as they have come to be called. Both the increasing desire of society to reduce the problems, and the increasing levels of education and of skills required for occupational achievement have produced a necessity to innovate. Although a variety of social and economic backgrounds produce culturally deprived children, numerically the central problem is that of the Negro youngster--and most often the Negro youngster from a fatherless family in which the primary source of income is public assistance. In any strategy of breaking the self-defeating cycle of discrimination, poverty, dependency, and educational and occupational inadequacy, the school system and the potentialities of the new media are crucial.

Thus, the social structure sets the framework in which the new media operate in the larger society and as part of the school system. At first inspection it appears that in an urban society the diversity of social backgrounds and personal capacities of the student body, as well as the complexity of the occupational system into which they must some day fit, seem to require that the new media in the educational setting adapt to an increasingly heterogeneous audience. In this regard, the content of education has become more and more specialized, and it would seem that the principal task of the new media is to reach more highly differentiated audiences. On closer reflection, however, it appears that for each of the essential functions of the mass media--information, socialization, and mobilization--modern society requires of the mass media an equally strong emphasis on symbolism and content which are unifying and inclusive. Urbanism as a way of life persists because there are common values among the urbanites. The particular and specific needs and demands of the members of the audience must be articulated with those of the largest social units of society and, in a sense, mankind as a whole. The mass media are "mass" in the sense that they reach out to encompass wide audiences, and therefore must emphasize what is common among men. Therefore, in each of their essential functions the new media must strive for an equilibrium in content to meet both of these fundamental needs--for specialized content and for unifying symbolism

Because of the trends in the larger society, the education system has faced two major challenges in recent years: first, educational preparation for adult life has become more complicated because of the higher levels of intellectual, technical, and social skills required in a complex world of continuous and rapid social change and international competition; second, the demands upon the school have increased in that the revolution of rising expectations requires the society to seek to end poverty and decrease social deviance. The school is asked to do this by serving the special needs of different groups and, especially, by assisting minority and culturally deprived students to meet the minimum standards of educational attainment required for success in the larger society. Because of these two trends, the socialization and mobilization functions seem to loom more explicitly in American education today. Moreover, these trends help account for the pressures to make use of the new media quickly to educate, while, simultaneously, illuminating some of the dilemmas involved in their introduction.

The educational format

Thus, it becomes necessary to relate our speculative analysis of the sociological dimensions of the new media to underlying questions of educational policy. For this purpose, we shall distinguish between two major types

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of educational format--cutting across elementary, secondary, and college schooling--observable in the United States today. The first of these formats we shall call standardized education. In this format, each specific type of institution treats its student body on a uniform and mass basis. Emphasis is placed on the acquisition of specific skills--technological and even social adjustment skills--and teaching is largely informational. We shall refer to the second format as individualizing or problem-solving education. In this format, emphasis is put upon differentiated treatment of the student body with the end of developing both the technical skills and the personal self-esteem of the students. In this format, more explicit attention is paid to the socialization and mobilization functions along with the information function.

The problem, as we see it, is that the rapid introduction and widespread use of the new media will exert a pressure toward greater reliance on the first of these formats, the standardized type. This format can have the consequence of maintaining a uniformity of treatment of broad categories of students, routinely and inflexibly. Moreover, as is the case with language laboratories and teaching machines, such individualization as the new media provide may be almost wholly limited to informational learning.

Further, it is possible that the new media will stimulate an increase in the social stratification of the education system. In the United States, despite a decentralized administration, the educational system has been relatively unified because it has been a comprehensive school system, avoiding the rigid two-track feature of European education. The sheer increase in size, and the growth of specialized education along with heightened demands for higher levels of academic achievement, place a great strain on our comprehensive system, however.

It is true that any system of education must develop a system of internal tracks. But the quality of the educational system depends in part on its capacity to shift pupils from one track to another in order to guarantee the opportunity for maximum growth and development. Moreover, the quality of the education system also rests partially on its ability to offer the pupil individualized education regardless of the track in which he is proceeding.

Given the economy and utility of using the new media in a relatively standardized format, it is necessary to investigate whether or not there is a tendency for only those educational institutions which have abundant resources and a high commitment to problem-solving education to use the new media in ways which would make possible individualized educational experience. In an extreme form, the result could be the development of a new form with two rigid tracks--standardized and problem-solving education. The major resources of the mass educational system would go to the routinized production of technicians, while a small sector of the system would provide problem-solving education for potential creative elites in special and privileged settings.

It is our assumption that such an outcome is not inevitable. Under proper administrative organization, the new media can contribute to individualized and problem-solving education, despite their great potential for standardization. It should not be overlooked that standardized education is widespread under traditional procedures of textbook teaching and poorly trained and inadequately motivated teachers. The issue is not that the new media per se introduce standardization, but whether or not they stimulate a new administrative basis for standardized education. To the extent that the new media increase centralization of authority, contribute to inflexibility in curriculum, and heighten a loss of professional autonomy, they will be self-perpetuating and even more difficult to cope with than the old-fashioned modes of standardization.

The remainder of this paper will focus on how the educational system adapts to the new media, with an eye to how these adaptations relate to the question of standardized versus problem-solving education. The new media enter an educational stage already stocked with ongoing roles of teacher, student, administrator, professional group, government, foundation, and education-serving private enterprise. The outcome depends on complex interactions upon the various actors in this setting. As an introduction to this analysis of the social scene, we shall turn now to an intensive examination of the contrasting cases of educational television and textbooks viewed as illustrations of cases of impact of the new media on the social organization of education.

Contrasting Cases: Educational Television Versus Printed Texts

The impact of educational television and the new developments in texts and printed mass media offer a striking contrast in social change. The sharply differing consequences are a result not only of differing technologies but of the contrasting administrative organizations which have developed and introduced these media. Paradoxically enough, although there exist no adequate data, there is good reason to believe that to date the impact of inexpensive textbooks on organized education has been much greater than educational television, despite the much greater attention given to the latter.

In the early 1950's foundations took extensive steps to develop a country-wide educational network. The results of these nationally directed efforts have been to create local transmitter facilities for educational broadcasting aimed primarily at grammar and high school students. These efforts to develop educational television facilities included an elaborate airborne system for broadcasting in the Midwest. This national technical system, contrary to original expectations, generally has not become a device for classroom instruction, but rather a telecasting system emphasizing popular culture, and aimed at the adult population (Powell, 1962). According to reports published in 1963, only 10 per cent of this telecast effort was directed toward classroom instruction. While the economic pressure on education may force a continued expansion of educational classroom telecasting, the results thus far indicate a failure of broadcast educational television to gain widespread acceptance in depth in educational institutions. Closed circuit television, much more successful as a college and university medium, has met the same resistance.[2] Extensive availability does not mean extensive utilization.

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[2] The organization pattern of diffusion of the new media is discussed in greater detail in Section IV, Institutional Adaptation to the New Media.

It is apparent that one factor conditioning the extent of use of televised classroom instruction is the flexibility of this medium, i.e., its adaptability in meeting varying classroom needs. Certain tendencies in patterns of decision making and authority with regard to the creation and use of televised materials already are apparent and promise to diminish this flexibility. The general direction has been toward greater centralization and standardization. This trend is due not only to the inherent technological characteristics of the medium, but also to the manner in which television is being introduced into the schools. The production of television content is expensive and, in order to reduce per-student costs, there is great pressure to produce for the widest possible audience for each program. In addition, television is being introduced from the top down by administrative decision, and is being developed by organizations operating outside the school system. The fact that these organizations are sponsored by tax-free foundations does not alter their highly centralized decision-making approach. Furthermore, these organizations are not subject to extensive review by professional organizations or by independent decentralized representative bodies. On the contrary, professional educational bodies are concerned mainly with protecting the copyright claims of educators who produce television material, a legitimate enterprise, but one unrelated to the central issues at hand.

As educational television becomes developed, the content of mass education is determined increasingly by specialists who are concerned with the techniques of mass dissemination of messages, rather than by professionals who are concerned with educational content. The division of labor, and correspondingly of authority, shifts as new personnel are brought into the educational institutions in order to develop these media. One critic stated, or perhaps overstated, the case in the following terms: to get the kind of program he wants, the teacher "must be prepared to struggle against men who call themselves experts." (White, 1962.) The producers insist on cinematic points, especially of the tradition of perfection in detail in order to maintain attention, and the educator is not in a position to argue to the contrary. Underlying these specific operational problems are the simple realities that these media have an existence quite separate from any use which may be made within the educational system, and that their development has been dominated and will continue to be dominated by the necessities of these other means.

Recent development in the printed media--the mass textbooks and other printed materials--are an interesting contrast to educational television because the result has been a contribution to individualization and use of a problem-solving format. In fact, one educator, Francis Chase, has stated, "I predict. . . that the most important revolution in education in the next ten years will result from the more imaginative and effective use of books and other printed materials." (Chase, 1961.) He argues that the fundamental advantage of books is that they are not programmed, even though some authors crudely try, so that books as a media can arouse different interests and enthusiasms in different children.

The fundamental aspect of the revolution in mass textbooks is economic; books now can be produced and distributed more cheaply. Accessibility to books has been found repeatedly to be a crucial variable in the amount of reading. While the evidence is by no means clear-cut, the amount of book reading in the United States, given the level of income and formal education, is lower than in countries such as England and Sweden. A variety of explanations have been offered ranging from inferior instruction in language arts and literature in the school system of the United States to greater availability of different leisure time activities and resources.[3]

But the level of reading in the United States is clearly tied to economic factors; both the cost of books and the limited number of retail book outlets have depressed levels of availability and reading. Before paperbacks, per capita outlets for books were fewer in the United States than in England, and the economic system for marketing books in the United States also weakened the bookstore. The revolution in paperbacks not only has reduced the cost of books but has increased the number of retail outlets where quality volumes are available.

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[3] The observation has been made repeatedly that traditionally dull and unimaginative "classics" have been the main fare offered to high school pupils, and reading is a chore from which pupils seek to free themselves when they graduate.

Of special interest has been the rapid development of school paperback book stores. In the two years since the Buffalo school system started a store in 1960, paperback book outlets have been established in over one thousand schools (Publishers Weekly, 1962). Such outlets also are being established in community centers and settlement houses. This movement not only increases the availability of quality paperbacks, but more meaningfully relates classroom instruction to the individual leisure-time pursuits of youngsters and helps to overcome the "chore" or assignment quality of reading in high school.

From a technological point of view, new printing processes could make possible greater standardization of textbook content. Nevertheless, the degree of standardization has diminished. There is a greater variety of content, an increase in the use of genuine classics and original materials, an expansion in the use of specialized research and monographic materials, and even an increase in the use of tailor-made textbooks. In numbers of titles, as well as in sales volume, paperbacks have assumed a mounting proportion of the total publishing activity, thereby increasing sales and reading. While in 1960 and 1961 only 14 per cent of the total output of books was attributed to paperbound volumes, in 1962, it accounted for 31 per cent of all American book publications (Publishers Weekly, 1963).

Equally important in the paperback revolution are the changing patterns of production and content. Because of the decentralized nature of the production units, textbooks have not become more standardized in the United States, despite the increase in volume. In fact, the paperback revolution has produced a striking decentralization of production and marked growth of diversity. Large mass market paperback firms, which represented 57 per cent of all paperbound output in 1961, no longer produce the major percentage of paperback titles. Although they continued to increase their production, in 1962 they claimed only 26 per cent of the total output. Thus, the impact of the new media on the publishing field has had the result of increasing the role of the small and middle-sized publishing houses in producing new and varied titles.

This trend has taken place even while there have been strong consolidation movements in publishing. The level of competition has been so great, and the per unit economies of large-scale operations so small, that financial control has not operated to decrease diversity in the organization and management of publishing companies to any considerable degree. For example, only one publishing company has more than 10 per cent of the market, and new firms enter the market with great speed. Thus, in 1950 there were forty-six companies active in college publishing, and even after a decade of widely publicized mergers, in 1959 there were fifty-one companies operating in the field (Clark, 1961).

From the point of view of the mass educational system, shifts in the content of paperbacks are equally important. Not only has the bulk of the paperback titles passed from the hands of the large mass market producer, but the types of subject matter represented in paperbacks also have shifted radically. In the past, fiction and literature were the core of the paperback industry, and these books supplied the basis for the dramatic upgrading of both college and high school humanities and language courses. In 1962, fiction and literature still provided the main source for reprints, but advances in the number of fiction reprints were minor in comparison to the accelerated gains experienced in original and reprinted nonfiction. Paperbacks have become diversified sources of old and new curriculum materials. In 1962, paperbacks accounted for almost one-third of the books on art, business, education, sociology, economics, language, law, medicine, and philosophy. Further, nearly one-fourth of the books on biography, history, religion, science, and technology were paperbacks.

The traditional economics of textbooks have led to the production of materials for the larger sales of a wholly national market. On the basis of the new technology, and with the growth of sizable specialized audiences making clear-cut demands, it has become possible to develop a wide variety of textbooks and supplementary materials for specialized regional and cultural audiences. At the college level, for example, the sheer growth in the size of enrollments makes possible the development of markets for very specialized high-level text materials. The authority relations in faculty groups are so organized--mainly at the university and college levels--that instructors are able to maintain and even increase their ability and responsibility for selecting materials for their classroom needs. Technological developments make it possible for them to use materials which were not economically feasible a decade ago.

In the past the national orientation of textbook publishers has meant a lack of attention to the development of materials specifically designed for Negro groups, for the culturally deprived, and more generally, for children growing up in the metropolis. This has been a result not only of sheer inertia, but also of the rural flavor which has persisted because of the domination of state-wide administrative systems controlled by farm areas. The revolution in textbooks is not only economic but organizational, in that textbooks are being created more and more to meet the needs of urban audiences.

In considering the ways in which the new printed media have contributed to problem-solving rather than standardized education, it is significant to note that not only has decision making over production been relatively decentralized, but decisions over use also have been relatively decentralized. The teaching profession has been able to maintain and even increase control over the choice of printed materials, as they have not been able to do with television.

These observations on the organizational aspects of printed materials hardly imply that this medium is adequately organized and institutionalized to serve the requirements of individualized instruction. For this purpose, the authority of the teachers to influence the selection and content of printed materials is frequently too limited, especially in elementary and secondary education. Moreover, the institutional framework of mass education for making decisions about the printed media has operated mainly with reference to the information function alone. There has been a general lack of concern, knowledge, and evaluation of the socialization and mobilization functions. For example, it usually has been ignored that in northern schools, Negro migrants from the South require different symbolism than do Puerto Rican migrant children. It also has not been recognized that these social characteristics undergo rapid change, so that mass-produced materials rapidly become outmoded.

In the typical metropolitan public school system, curriculum planning and development are heavily concentrated at the level of the superintendent and his staff, and yet the system must serve a great variety of student audiences. Working with standardized materials, the teacher has had to fall back on pragmatic and personal knowledge to adapt them to her students. However, in experiments, flexibility and decentralization have been pushed to the point where the classroom teacher becomes highly involved in producing appropriate materials. Programs have been started which give teachers of particular schools wide authority to develop text materials and enhance their professional status.

In turn, such a process of decentralized construction of the curriculum requires extensive internal discussion among the teaching staff which can strengthen professional competence and clarify educational goals. The standard curriculum designed for middle-class children is rejected under these circumstances. Clearly, these decentralized processes require specialized staff support of a technical nature. None of these trends can overlook the essential requirement of a common cultural core in the instructional materials. In the area of race relations, it is necessary to insure that Negro children do not simply have a Negro-oriented textbook series, and white students a white-oriented series. The formula which appears to be emerging involves an appropriate balance between standardized and specialized requirements.

This comparison of developments in educational and printed media has been instructive, for it indicates that circumstances of high centralization in the production and use of the television media have led to standardization of content, while decentralization in the creation and selection of printed media has led to greater reliance on the individualization of content. It is true that the differing technical characteristics of these two media have had much to do with these differences in social organization, but it must also be realized that these differences have developed in the absence of policies and practices consciously designed to generate decentralization. Even in the case of educational television, it appears that deliberate professional practices designed to further decentralization of decision making on production and use could put limits on the tendency to standardization, and bring a movement toward problem-solving education.

Institutional Adaption to the New Media

On the contemporary scene, the pressure to employ the new media, especially television and teaching machines, is much greater than it was during the emergence of radio. The pressure is so great that the new media will be developed and used regardless of social consequences. The new media are being introduced first, and then, secondly, the policy question of whether or not they are so organized as to increase standardized education or contribute to individualized education is raised. A national educational policy has not emerged which would sensitize government agencies and foundations to the impact of their practices upon organizational control, curriculum flexibility, and professional standards. But even in the absence of explicit policies to direct the development of the new media, it is possible to observe some of the trends in educational institutions that have emerged as these media have been integrated into the various school systems. The manner in which the educational profession is learning to live with the new media supplies clues for developing policies and practices for containing their disruptive consequences and maximizing their beneficial effects.

The institutional adaptations of the school system--private and public, elementary, secondary, and higher--to the new media can be characterized in terms of two master trends--one negative and the other positive. First, while there has been a widespread diffusion of the mechanical devices of the new media, this diffusion often has not meant extensive utilization. The result has been "token saturation," by which we mean the existence of wide availability of mechanical devices but their extensive under-utilization and compartmentalization from the main body of the educational experience of the students. Secondly, on the positive and adaptative side, elements in the teaching profession have sought to develop new procedures to build an effective organizational context to overcome the dysfunctions of the introduction of the new media.

Token saturation

Token saturation has taken place in part because of institutional inertia and in part because of the rigidities of the new media. Token saturation also has resulted because the new media are much more effectively subsidized than has been the case with other educational experiments in the United States. The reasons for the initial rapid diffusion are significant, and should be kept clearly in mind, because the initial generous support for the new media is no clear-cut indicator of the long-term organizational impact on the educational profession. First, these devices are being developed at a time in which there is tremendous expansion and demand for education. The rapid development of these new media is supposed to deal with the problem of teacher shortages and the ever-increasing costs of education. Yet, while the demands for education will continue to grow and expand, the teacher shortage in the years ahead, while it will remain, will decline in relative magnitude. Secondly, foundations and government agencies have allotted large sums of money to research and development for the new media. This has been an especially attractive area for them, because it involves a social problem, and yet at the same time is relatively noncontroversial. Thirdly, the prospects of an expanding market have meant that private companies have been prepared to make major investments in capital and new media devices. Fourthly, and by no means to be overlooked, Americans are more prepared to accept a mechanical rather than a social or professional solution to the problems of upgrading and expanding mass education.

As a result of these factors, plus the underlying propensity of American society to accept rapid technological change, the new media have had an extensive initial diffusion. In effect, administrators do not have the option of accepting or rejecting the new media. At a minimum they must show knowledge of these media and demonstrate to both their boards of control and their clientele that they are prepared to innovate with them. The pattern of saturation can be seen in the data collected in a national survey of principals conducted by the National Education Association (National Education Association, 1962):

Percentage of Principals Reporting Their Schools Made or Will Make at Least Some Use of the Following Media:

Media	1955-56 Per cent	1960-61 Per cent	1965-66 (Expectation)
Films and filmstrips			
Elementary	88%	96%	99%
Secondary	96	99	99
Language labs			
Elementary	27	36	74
Secondary	6	35	83
Tape recorders			
Elementary	54	74	93
Secondary	76	96	99
Teaching machines			
Elementary	22	26	71
Secondary	5	13	65
TV programs			
Elementary	25	53	84
Secondary	18	51	86

We are inclined to describe this diffusion as token saturation because the powerful pressures to innovation are counterbalanced by equally powerful restraints on utilization, so that the initial glamour of the new devices eventually diminishes. Token saturation also can be the result of organizational sabotage or professional rigidity, but it is our estimate that these negative pressures are relatively secondary in accounting for under-utilization of the new media. More fundamental is either the lack of understanding or experience as to how to use them. Even more crucial is the built-in rigidity of many technological systems which makes them unable to meet the varied demands of the public school systems. Many systems are just too elaborate and extensive to articulate to specific classroom needs. Thus, for example, the expected national diffusion of airborne television has not succeeded, aside from the technical and economic aspects, in part because its rigidity was so great that it could not produce a curriculum flexible enough to meet the needs of the variety of cooperating institutions. Or, as mentioned above, educational television finds a larger audience in leisure-time listening by adults than by meshing in with the complexities of academic institutions. The structural rigidities of the new media also emerge when the teaching staff feels an inability to make use of these devices to handle remedial work or to cater to the special needs of superior students.

To the extent that these devices are small and flexible--that is, to the extent to which they are really not mass devices--to that extent they can more readily adapt to the special needs for individual development. But, in general, the more elaborate the machinery and the greater the audience, actual and potential, the greater the rigidities which exist in linking the new media with the requirements of the educational system and the more likely token saturation. Finally, token saturation is an effective response on the part of administrators who must innovate, but who are yet at the same time seeking to prevent their institutions from being unduly disrupted by mechanical devices for which there is not yet an organizational procedure for effective utilization.

It is therefore striking to see the extent to which teaching machines at the grammar and high school level have been sold to individual parents of school-age children while school systems have responded much more slowly. Commercial educational companies specializing in encyclopedias and equipped with years of experience in door-to-door persuasive salesmanship have entered this field with extensive research and development programs. They have been much more successful in selling teaching machines to parents than to high schools. For example, in the two-year period after 1960, one company sold 150,000 machines in the $20.00-$25.00 range, along with programs at additional cost. The family as a consuming unit makes these decisions easily, although it is not necessarily equipped to make extensive or effective use of the machine. The fad overtones will wear off rapidly in family purchases, while the resistance from the school systems may well be the basis for a more long-term and meaningful search for effective integration of these devices into the educational program.

Adaptive response No. 1: Restructuring teaching tasks

If part of the educator's response to the new media has been resistance and token saturation, one also can identify adaptive and creative efforts to make use of these media to assist the development of problem-solving education. Three different areas of response are worthy of note: the restructuring of tasks among teaching professionals; organizational experiments designed to increase the individual development of students; and efforts to use the new media in such a way as not to detract from face-to-face interaction between teachers and pupils. These adaptations are more relevant as indicators of future patterns than are statistics about diffusion.

In the restructuring of the work tasks of the teaching profession, it is clear that the new media, even under optimum conditions, do not displace existing teaching procedures but instead modify them. One way of enhancing the use of the media is to decide not to use them at their so-called maximum economic advantage, that is, not to use them to reach the largest number of students at the minimum costs, which, as noted above, creates organizational rigidities. Instead, one can discern a major emphasis on inhibiting the mass character of the new media by administrative decision. Some professional educators attempt to control the rate of social change and insist on employing only those techniques and technological devices that are appropriate to the educational task at hand. Token saturation by the mass media of communications thereby gives way to more selective and more penetrating teaching procedures. For example, in high school science, it is obvious that highly complex equipment and demonstrations cannot be made available permanently to all schools for general educational purposes. The effort to employ mass dissemination via classroom television at one time in the day is not a wholly satisfactory approach because of the cumbersome and difficult problems of integrating such broadcasting with the whole cycle of instruction. There is an alternative, apparently more effective from the point of view of student involvement, of using mobile demonstration units backed up by appropriate audio-visual materials which travel from school to school. Such devices can be used selectively to provide materials for enhancing instruction, while incorporating the teaching skills of classroom teachers.

The composite history of the efforts of an energetic professor of psychology to reduce introductory psychology to a closed-circuit television program is indicative of the effect of educational television on the division of labor at the university level. Combining optimism and a stimulus-response model of education, he saw no reason why the whole introductory psychology course could not be made into a video tape, thereby freeing the staff for research, student counseling, small group discussions, and even community services. Together with a number of his colleagues he developed a television version of introductory psychology which involved a large amount of time and funds. The first offering of the course to three sections on an experimental basis produced reasonably satisfactory results. Probably, there was some "Hawthorne" effect. The faculty discussed each showing among themselves before and after, and the students recognized that they were part of an experiment. After the initial test run, the staff believed that this expensive medium could not be used for the entire student body enrolled in introductory psychology, and also could be exported to other universities. However, even in the first round of presenting the basic course to the entire student body, only a portion of the tapes were used because the staff recognized the need for allowing more time for group discussion and also for actual participation in laboratory demonstration.

The television material modified the course, converting it into a staff course. The brightest faculty members and the most creative graduate assistants balked at what they thought was a straight-jacket, and at the excessive amount of time involved in coordinating all of the elements of the instructional program. The professor who originally prepared the television lectures went on sabbatical during the third year of the experiment, and then subsequently extended his sabbatical to engage in full-time research. The new senior professor found it difficult to organize a course with a local hero who was absent. Some of the key lectures needed to be modified in the light of new research and new trends in introductory psychology. In the end, the full experimental course in closed circuit television was reduced to another resource of a batch of video tapes to be fitted into the introductory course along with laboratory demonstrations, guest lectures, and even chalk talks on the blackboard.

Other nearby institutions with more limited resources were very much interested in the course, and it served their needs more effectively than those of the university which prepared it. Its student body was mainly adults, the bulk of whom were not taking the course for university credit. A regional association of universities and colleges felt that a new course should be prepared incorporating the experiences of the original experiment. An elaborate administrative organization was set up to prepare the new course, but from the very beginning it was assumed that it would be integrated with formal lectures and discussion groups. The purpose of the television presentations in the cooperative course was less involved with the dissemination of information and more in developing enthusiasm and interest in the frontier problems of psychology. The effort was made to increase the dramatic quality and to show psychologists as interesting and creative men. The original research psychologists who were in on the initial experiment tended to withdraw from the enterprise, and the development of the course was more in the hands of new media specialists and younger, less experienced, but highly ambitious faculty members. This was a case in which educational television was emerging as another specialized career pattern in academic life.

Developments in curricular materials for high school science, particulary for physics, provide an actual case study in which the new media have been used creatively to improve the quality of teaching. Heavy reliance has been placed on films and the development of a "national curriculum." The physics course for high school students, developed under the energetic leadership of Professor Jerrold Zacharias, of Massachusetts Institute of Technology, was the first, and served as a prototype. Under the Physical Sciences Study Committee, supported by a variety of foundations and extensive grants from the National Science Foundation, a number of leading physics professors formulated a curriculum for high school physics which was supposed to be "recognizable to a physicist." At the insistence of Zacharias, the highest priority was given to the preparation of films which were designed to present real scientists in real laboratories who set forth the "real nature of important problems in physics." These films, which were to set the tone of the course, were produced with much greater expertise and cost than is usual for educational films. A basic textbook was prepared along with an extensive series of supplementary readings. In addition, since science students need to work with real equipment, a number of very inexpensive instruments were prepared for mass distribution. By 1962, nearly 2,500 teachers using these materials were reaching about a quarter million students annually. Because of the high prestige of the scientists who prepared these materials they were able to resist successfully any mechanical educational testing program designed to evaluate the program. It was generally recognized that the program greatly increased the intellectual quality of high school physics.

It can be pointed out that this program introduced a high degree of centralization in the curriculum. But physics appears to be in the area which does not suffer from such centralization. A small group of physicists was able to set the intellectual tone for high school physics. Their mutual self-respect and their mutual self-criticism undoubtedly served to produce the basis for an effective program. It is doubtful whether the same model of a national curriculum could extend to other areas. But most important at all, it is striking to see that all of these pre-packaged materials had to be integrated with the needs of the individual teacher. Materials were tested out by extensive experimentation in the classroom. To some extent the program succeeded because it was labelled as a special program, and because of the high prestige of high school science. More important, the typical teacher had to be retrained by participation in at least one summer training session. It was not the production of new media materials alone but the articulation of the program with effective teacher training that made the new media relevant. Strikingly enough, in the end the program has not been justified in terms of information or the increased ability to teach physics as a high school subject in and of itself. It has been justified in terms of socialization goals, because it sought to make high school curriculum more challenging in general, and because it was an effort to develop attitude by fighting "anti-intellectualism" in the high schools.

A basic proposition of sociological researchers is that under certain conditions and with certain kinds of messages a two step flow of communication is highly effective. By means of the new media this two step flow of communications can be used by providing specialized programs for teachers in order to supply them with supplementary materials. The teachers devise new materials from these programs and in turn select those items which they believe to be relevant for their classroom assignments. For example, in some big cities special programs go out each morning over television to assist the teachers in developing their social studies programs.

But there are limits to the extent to which the new media can be articulated with teaching, given the existing social organization of the profession and of the classroom. If teachers are to use the new media flexibly and selectively they need time free from the classroom for the previewing, consulting, and deciding. Such flexible use of time is available to some extent in the format of team-teaching, the expansion of which may provide an effective setting for the use of the new media (Ohm, 1961). Another device may be the special training of teaching personnel so that mass television assignments can be rotated among the pool of teachers. Such procedures may have the effect of preventing television teaching from becoming routinized. In turn, training and involvement in television teaching has the side effect of sensitizing those who must work with television transmission on the receiving end.

The popular prediction that there would emerge a class of superteachers and television stars has not yet come into being and does not seem likely. Some teachers, particularly at the college and university level, have for a period of time become highly involved in the substantive production of new media materials. The specialization that has occurred has been principally in the technical production of new materials. At this level, the specialty consists mainly in the accumulation of experience grounded in media problems. The bases of expertise are mainly technical knowledge of the media and administrative success in bridging the gap between the media and the educational institution, or (as is the case in the development of the new physics materials) intimate involvement in developing and testing new materials in the laboratory and classroom.

There is a need for new levels of expertise not only in the production of materials but also in helping the teachers to integrate the new media with traditional approaches. In large part, this task has fallen to the audio-visual specialist--the "materials man." The role of such a person generally is to act more as cataloguer, librarian, and supplier, then interpreter and in-service trainer. The number and variety of old and new media offerings, in many subject matter areas and over many grades, usually is so great as to make it unlikely that the audio-visual specialist will have either time or motivation to become expert in any one subject matter area, much less in how this area might relate to the teachers' classroom activities. Thus the specialist usually is able to furnish the classroom teacher only with lists, general "guidelines," and superficial aid.

Adaptive response No. 2: Individual development

Along with modification in the work tasks of the teacher, it is argued, an important aspect of the new media is their capacity to enhance the freedom of the superior individual student to move at his own speed, or to get such additional remedial work as is necessary to bring him up to his age level. It is already clear from present uses of the new media that, while the new media can make a contribution in this regard, especially on informational levels, this consequence is not to be exaggerated.

For example, the teaching machine is presented as being especially relevant for the development of individualized education, at least in informational aspects, because of its ability to permit a student to proceed at his own tempo. The prospect of computer feedback is offered as a further means to this objective. Any psychological consequences such as depersonalizing the relationship between teacher and pupil is counterbalanced by this presumed advantage (Fritz, 1961).

But, if one examines the way in which students move through the educational cycle, it becomes clear that the organization of the school system is more important than any particular teaching device in setting the educational pace. The structure of the school system is grounded in the procedure by which students move through the educational cycle in class groupings. At the end of every six months, or every year, the student is graded by examination, and the educational process is directly linked to this examining activity. As a result the students are exposed to the educational process at a relatively uniform rate, and the school's response to variance in the capacity of pupils to learn is to assign students to different tracks. In theory, programmed learning should make it possible for a student to proceed through the educational cycle on the basis of his own capacities and skill. At a minimum, this implies that students can proceed through a given block of instructions--six months or a year--at their own speed. Modification of the teaching process to this extent, while noteworthy, is hardly likely to be the basic reform. Only when the school makes it possible for a student to proceed beyond a grade level at his own speed, can we speak of an organizational reform of consequence.

Such a reform is found in "non-graded" or "multi-graded" school programs or programs for "continuous development," in which the student is encouraged in each particular subject to proceed beyond normal grade level when he is able, and in which he is given more time to overcome deficiencies, such as those of culturally deprived background. As yet, however, there is no evidence that programmed instruction has assisted in those administrative organizational reforms required to produce these programs of education. To the contrary, the movement toward "continuous development" education is unrelated to the new media, although sometimes it might be a side effect. These programs are a result of efforts of educational administrators who are acutely aware of the social processes of classroom instruction and who seek to overcome the standardized character of American education. Educators with these commitments will be able to use the new media selectively and to advantage.

Adaptive response No. 3: Interpersonal contact

Another crucial area of adaption and experimentation with the new media is involved in the "feedback process," and the levels of direct interpersonal contact between student and teacher. The literature on audio-visual education is replete with discussion of the necessity of adapting the new media to insure direct interpersonal communication of the student and the faculty. Specialists in the new media have not been modest in their claims for they have felt that, contrary to the views of the popular critics, the new media would enhance the possibility of feedback. Thus, for example, Professor Charles J. McIntyre claims ". . . to repeat, one of the advantages of using the new teaching media in large classes where significant interaction between student and teacher is impractical is the increased time the faculty has available for individual or small group contact. It will be the faculty's responsibility to devise situations in which this time can most appropriately be used, but students will have to learn to take advantage of them and make them profitable." (McIntyre, 1963.) Linked with this claim is the prediction that the student-faculty contact hours in moderate to moderately large classes will be decreased while there will be an increase in large group instruction via film and television. There are no hard data available to assess the long term consequences of television teaching on classroom size.

Underlying these anticipations is the notion that television and, particularly, teaching machines make possible a reallocation of the teacher's time. It is interesting to note here again that there are no studies adequately describing the reallocation of teaching time with the use of television or teaching machines. There is every reason to believe that there should be some increase in productivity, but this remains to be demonstrated. Yet, it is abundantly clear that where television is being used on an extensive basis, concerted effort is needed in order to deal with the problem of feedback and interpersonal contact. In reporting on the Chicago Junior College experience with television, the authors point out that it was found essential to develop feedback devices beyond the mailing back of assignments. Special time was allotted for telephone conferences each week, face-to-face conferences were scheduled throughout the semester, and a division of labor was set up between the teachers who appeared on television and the section teachers who handled a great many of the administrative details (Erickson and Chausow, 1960).

On the basis of existing theories and direct observation, it is clear that most speculations that the new media will increase primary face-to-face discussions require critical assessment. Again, the concept of communication as a social process is relevant. First, it should be noted that these speculations do not adequately interpret what takes place in a lecture, and what happens when a lecture is recorded by television. A lecture is a process in which a man is interacting with his material, with his audience, and with direct feedback from students and faculty before and after the lecture. This is a continuous process, whether it be for an ordinary lecture or a lecture of a great teacher. The wide dissemination of a great lecture permits students to watch a man interact with his subject matter. But this is only part of the process of education. Thus, even the ordinary lecturer responds to the mood of his audience and the changes in the social and educational environment in which he finds himself. Lectures become stale because the social context changes, and therefore, whether it be in television or in direct lecturing, upgrading and modification is essential to enrich the educational process. Secondly, the notion that the free time that teaching machines create would permit the classroom teacher more time for individual supervision of students is again somewhat of an oversimplification. Let us assume that the teacher does have more free time for individual supervision, although it can be pointed out that with the introduction of teaching machines he must spend more time in administrative procedures. Individual supervision is appropriate for some students, but it has its limitations and is a costly device. Teaching is a group process and an effective teacher makes use of the interaction between students themselves as well as the interaction between the teacher and the student. In fact, there is every reason to believe that great increase in teaching productivity results not from freeing the teacher from a role as teacher, or decreasing direct contact with students, but from increasing the teacher's capacity to mobilize resources among the student body.

Thus, the new media do not eliminate the responsibility of the educational profession for maintaining and enhancing effective systems of interpersonal communications. These contacts do not develop automatically with the use of the new media, and they may be expensive and difficult to create. Any crude notion of increased productivity on the part of the educational process using the new media must take into consideration these efforts. Furthermore, concern with feedback is an expression of professional standards, and of the entire organizational setting in which they operate. If it is part of the culture of the educational institution to emphasize group discussions as a result of leadership and tradition, then these are likely to take place. The new media are instrumentalities which, if properly used, will not stand in the way of such developments and, under certain conditions, can make a positive contribution.

This is not to underestimate those specific contributions that the new media can make when they are particularly adapted from a technological point of view to assisting selected aspects of the feedback process. The teaching of reading to youngsters is a case in which simple technological devices may be of crucial importance. In the teaching of reading the effective teacher is concerned with increasing the amount of individualized instruction by, for example, breaking the class into smaller groups. The teacher is not concerned merely with imparting a technical skill which will permit the student to acquire information. If reading is taught creatively, it is part of the process of socialization in which the student increases his capacity for exploration, and in which he experiences personal growth. Mastery of reading produces not only a sense of competence and self-confidence but, in a process which is only dimly understood, personal satisfactions and a basis for personality development and human interaction.

The effective teacher enhances these processes by making reading a group experience. He realizes that reading is a psychological process of absorption which is directly related to the student's ability to communicate, first orally and subsequently in written form. Thus, the teaching of reading involves teaching the student to recognize the spoken word, and in turn, to speak effectively himself. Therefore, the teacher reads to his pupils and listens to them read, and in turn, attempts to make use of his pupils to teach each other the language and reading skills.

In this regard, available research evidence indicates that exposure to commercial television does not tend to stimulate children to greater involvement in the reading processes. Those children who have strong reading interests grounded in their own personal inclinations or family influence are not distracted by television. Some of these with the strongest interests may even find some peripheral stimulation. However, for the weakest, who are turned back on their self-generating world of fantasy, exposure to commercial television does not encourage the development of language skills or the desire to read. Television exposure does not appear to stimulate the basic interpersonal process related to reading development. By contrast, the classroom teacher who has a tape recording machine available has an important adjunct to the teaching of reading. If she is able to allow the students to hear their own voices, or to listen to themselves and to their peers reading, she has a device for stimulating them, assisting them to correct errors, and for indicating their progress. The widespread use of tape recorders may emerge as an especially important device for helping to overcome the handicaps which the culturally deprived have in learning the basic language and reading skills.

The question of interpersonal stimulation also raises the issue of the role of the new media in education for creativity and innovation. Creativity involves complex psychological processes of which we have only the most limited understanding. It also involves a social environment conducive to exploring new materials and originating new ideas and practices. At the very outset it is necessary to make a distinction between those elements of creativity involved in eminence and those involved in competence. Men of eminence are likely to be self-propelled and therefore the stimulation of creativity is not relevant for them. The educational issue of creativity is related to men of competence. How can educational experiences be so organized as to stimulate the competent to learn on their own and innovate? The limits for stimulating creativity are perhaps narrow, but educators must be alert at least to the danger that their practices may inhibit and thwart creativity.

The new media, especially teaching machines, have been repeatedly criticized in that they run the risk of "snuffing out originality and inventiveness." Merely to learn more basic information at a more rapid rate is hardly to develop originality and inventiveness. It is highly unlikely that in the near future systematic empirical research will shed crucial light on this question. Like so many other basic issues in modern society, there must be wide areas for the toleration of ambiguity. The critics of the new media exaggerate their criticism, but on the other hand, the advocates of new media overlook inherent dangers unless alternative and supplementary educational experiences are built in. If there is any principle worthy of analysis it is that originality and inventiveness come from an exposure to a variety of educational experiences and in this variety there is no reason why exposure to the new media cannot be a relevant dimension.

Finally, it is appropriate to speculate on the impact of the new media on the creativity, morale and autonomy of teachers themselves. While this subject remains little researched, it has given rise to considerable concern. Typical is the point of view expressed by W. R. Lee, in an essay entitled "Mass Media and the Pupil-Teacher Relationship," in which he highlights the negative consequences which he believes will dominate (Lee, 1960). In his view, before the advent of the new media, the teacher was the unchallenged authority in the classroom, a position which is weakened by the introduction of outside experts via television. The role and impact of the teacher in the eyes of the pupils has and will continue to decline. This change, although it has benefits in reducing authoritarianism, seems to make teaching more difficult, and it also seems that the competition of commercial television has made the task of the teacher harder. Lee's approach seems one-sided in that it overlooks the added resources that the outside expert brings to the classroom, however. As has occurred in many other roles in modern society, the teacher becomes more and more transformed from an authoritative agent to a coordinator of a variety of expert personnel and resources.

Thus, it appears that Dan C. Lortie's analysis of the emerging rewards for the teacher presents a more balanced appraisal of the impact of the new media on the teachers themselves in a framework similar to our social process analysis (Lortie, 1962). Like Lee, he points out the immediate negative consequences of both television instruction and programmed instruction on the teaching profession. He sees these instruments reducing the intrinsic psychic rewards which are linked to the craftlike aspects of teaching to the extent that these devices stultify interpersonal relations with students and create a standardized format of education.

But on the adaptive side, he leaves open the possibility there will be some increase in rewards for the teachers because of an increased level of professionalization. The new media may well increase colleagueship as teachers become sensitive to feedback on their performance from other teachers. His underlying point about increased professionalization appears to be crucial, although the specific mechanisms may be less obvious than those he describes. The teaching profession is one in which the practitioner is relatively isolated from professional peer contact in the day to day task. The conditions for strong peer solidarity are limited. The new media may help to create more lateral communications, not so much as one teacher sees the performance of other teachers, but more as a result of the team concept that is necessary, as mentioned above, to implement the variety of new media and their flexible use. Similarly, to the extent that the new media increase the productivity and effectiveness of teaching, higher salaries and increased prestige are likely to result. In balance, any estimate of the advantages of the new media, and any analysis of the adaptation of the profession to the new media, must include the impact of the new media on the teachers themselves.

Long-Term Implications

Overall, we see the new media as producing no drastic revolution, but instead continuous adjustments and counter-adjustments. Professor William Fielding Ogburn asked repeatedly why his predictions that radio would fundamentally alter educational institutions did not come true. He literally foresaw most students in high school and college being taught by radio. Radio failed largely because it was a medium which was too centralized for the social needs of the United States. It failed to solve the problems of interaction among faculty and students. It failed to adapt as a social process to organizational problems of the field of education. But in the 1960's, educational radio is having a rebirth as it finds more limited and more realistic goals.

While the claims for the new media are at times equally overreaching, the actual implementation is more pragmatic and more functional. The task varies at different levels in the educational system and in terms of the different functions of information, socialization, and mobilization. Contemporary patterns may not emerge as persistent trends, or as the most relevant to the development of individualization and problem-solving education. In the contemporary period, which still must be labelled the introductory phase, claims for the new media are made principally in terms of their capacity to disseminate information. But to venture a prediction, the importance of the socialization and mobilization functions of the new media will be recognized more fully in the years to come.

Further, it will come to be seen that although the new media may be most useful for teaching information in the early years of the student's life, as a carry-over from commercial television viewing, as the student matures his capacity to absorb information becomes more self-generating and less related to specific classroom techniques. At this point, then, the new media, particularly television and films, can become, strangely enough, more powerful in the areas of socialization and mobilization. At the high school and certainly at the college levels, students are more prepared to accept and make use of the dramatic quality of television and its particular sense of immediacy. Whether the subject be in the humanities or in the social sciences, the new media are vehicles for great performances--staged and real. In these terms the greatest potential of television, for example, may not be for routine instruction. The power of this medium may reside in its ability to bring to mass audiences outstanding personalities and crucial events. These elements are essential aspects of the socializing and mobilizing functions.

The educational system is also a school for citizenship, and not only in the sense that the student increases his knowledge about government and his intellectual powers. It is a school for citizenship in the direct sense that interpersonal relations and authority patterns in the school condition a student's attitude toward the larger society and the political processes. Training to take part in the democratic process begins in the school, although at this level a student's responsibility may indeed be limited. In the school, however, administrative procedures are crucial to his education for citizenship. If he recognizes and feels that his teachers have effective competence and autonomy, and if he recognizes and feels that equality of opportunity is an essential administrative principle, then he is getting appropriate citizenship training for a democracy. The introduction of the mass media into the school may weaken citizenship training--if the media reduce the competence and authority of the teacher or if they increase standardization. The new media cannot perform this task unless there is a continuing effort to guarantee a decentralized process of decision making--even though the media themselves tend toward centralization. Likewise, the new media, and especially television, offer vast potentialities for presenting the dramatic materials out of which the basic elements of political education are built.

More formally, we might state the problem of making satisfactory use of the new media in all of their functions as one of achieving a real, not marginal, differentiation of content and style. We are dealing with a social process in which there is high expertise, a powerful resource base, and oligarchy on the part of the producers, and low expertise, high dependence, weak resources, and lack of organization on the part of the users. Surveying the textbook industry, we saw as a seeming alternative the development of a relative diversity of contents because decision making about selection and use was relatively decentralized, with a mass of users making separate selections. In the case of the mechanized new media, however, because of their technology, expense, and history, the users are in a much less favorable position to fulfill their needs, however variegated, individually. Teachers and school systems alike tend to be captives to that which is produced. Thus, if decentralization of decision making is to provide an adequate basis for product differentiation with reference to the new media, ultimately there probably will have to be decentralization not only at the user's level, but also at the level of decisions about media production.

In the long run, the new media may provide not an absolute economy, in terms of per student cost, but a relative economy, relative to an increase in learning. We have argued that attention must be given to the organizational conditions of the production and use of these media, and suggested some potentially helpful changes. Hopefully, research on the impact of these new media will begin to put less emphasis on the similarities and differences

in information acquired in experimental settings with new media, and will turn instead to the analysis of the social processes in actual classrooms which use the media in different organizational formats and for the full range of educational functions.

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CHAPTER VII

THE IMPACT OF NEWER MEDIA ON THE PHYSICAL PLANT OF THE SCHOOL

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Introduction

The physical plant of the school is regarded variously by its occupants, operatives, and patrons. They view it aesthetically as an excrescence or as an artistic creation. They view it architecturally as utilitarian, ornate, inspiring, forbidding, cloistered, mundane, dignified, or garish. However they view it, they judge it most tellingly as a social institution not as a building. What goes on in the space is the touchstone criterion. For many of them then, the building and the instruction are independent of each other. Few, of course, are willing to contest the relative importance of the teacher in the educational process; the point which is lost or misplaced is the instrumentality of the teacher and the building. Both contribute wisely or foolishly, centrally or incidentally to the instruction of the young. The environment as an educative medium has been largely ignored because its cost is too immediately apparent. School patrons seem to prefer to pay for shelter rather than artistry on the assumption that the teacher will work customary miracles. But the environment also teaches; the disinfectant smells from toilet rooms, the drabness of unadorned cinder block, the noisy assaults of an amalgam of extraneous sound, the glare of uncontrolled light sources, the insult of a steel locker as one's only private domain.

The concern of this chapter is to assess the effects of new media on the school building--or to speculate on what effects there might be. The idea of "school" qua "school" and various rationales for the grouping of youngsters for instruction are discussed. Alternative arrangements are posited for purposes of illustration, and some reality models are presented.

Finally, there is a discussion of various building requirements affected by the media: spatial, environmental, and service.

School As We Know It

The notion of the school as a place described by the location of a building is a truism throughout civilized cultures. "School" may create a congeries of different responses about who goes there, or what goes on there, but the idea of grouping the young for some sort of instruction in the traditions, superstitions, folkways, and taboos of the society is such a commonplace that scarcely anyone stops to think about it, or of possible alternatives.

An array of the assumptions which underlie the assemblage of children for instruction would probably be headed by a statement of the obvious case for efficiency (so far as society is concerned) in confronting a trained instructor with a number of untrained children so that he may impart his expertise to more than one at a time. It is also inefficient, uneconomic, and difficult to provide costly and complicated equipment, libraries, materials, and paraphernalia on an individual basis, and it would therefore seem reasonable to suggest that they be used in a common place, under the supervision of trained instructors. Further, these trained instructors profit from association with each other, and the character of the instruction is thus enhanced if the individual teachers do not impart their expertise in isolation.

The big argument for the grouping of the young is, however, a social welfare argument. As the economic necessity of child labor in the home has progressively decreased, adults have had to devise artificial occupations for the young so that the adults themselves could carry on the ordinary burdens of male-female divisions of labor without distraction. This has largely meant an increase in the length of the school day, the length of the school year, and an increase in the total duration of years of schooling; not to mention the independent recreation programs, arts and crafts activities, and the competitive sports activities (Little League baseball, hockey, etc.) which are designed to satisfy the aggressive impulses that adults have for their children and for other adults which they have no way of expressing politely.

The cheapest solution for society has been to herd the immature together in large clusters, and to institutionalize the relationship so that it is never fundamentally questioned. At the same time, however, the institution can be used as a convenient scapegoat for the projections of a culture which cannot readily admit its own inadequacies.

All of this has been accomplished by a profusion of materia technologica which has contributed to the escalation of living standards, and to the decline of the servant class. Thus, for all the gadgetry available to the modern housewife, she is largely the slave captive of the consoles she commands. Where is the hired girl to whom the tasks of drudgery can be consigned; and where indeed, are the affable, highly skilled, and obsequious tradesmen who wait upon the homeowner's every whim? Neither is now available to the modern mother or father who must themselves, in various ways, take on many of the characteristics of the servant class. The mother does the washing, ironing, cooking, scrubbing, mending, etc., and the father paints, does the carpentry, most of the repair and upkeep, plus the manicuring of lawn and garden. Needless to say, under such stress, adults have generally been overjoyed to transfer as much of the formal instruction of their young as is possible to some other agency.

One might then consider teachers as servants of the society, or at the least as custodians of the young while the adults busy themselves with the operation of the culture. Of course, having to confront the efficient arrangement of groups of youngsters, teachers then spend most of their professional energy in devising ways to individualize instruction. After all, how can a single diet possibly excite equally the highly unique palates of thirty different individuals? A piano teacher on a one to one basis is able to tailor her instruction to the idiosyncratic needs of her individual students. Group instruction, on the other hand, suffers first from sheer physical management problems, second from obvious teacher limitations (inability to respond to multiple stimuli, even if each discrete stimulus could be perceived), third from a paucity of materials, and finally, from the erroneous presumption that students can be adjusted to a standard program.

It should be noted that clusters of teachers also bring on management problems, which probably occur with any collection of individuals, but which with teachers are likely to have their roots in the tradition of privacy they have enjoyed in their classrooms. It has been difficult to keep the classroom doors open, let alone take them off, or get two teachers to join in a team effort. The extent to which a teacher's classroom becomes a private kingdom probably reaches its apogee in colleges and universities, where "academic freedom" is too often invoked to protect a quality of instruction so shoddy that it could not bear the most casual inspection. Everyone who has tried to manage some merit system, or conduct an evaluation of instruction knows with what pain small evidence can be gathered.

The foregoing discussion is to suggest that very strong reasons exist for the apparent model rigidity which we suffer when we begin to think of other systems for the instruction of the young. We have always had schools; I went to one much like the one you went to and that our fathers went to. It worked, so why bother to disturb a going system, unless, of course, it can be done more cheaply? It seems though, that every improvement in the quality of education always costs money--particularly better teachers. It's not like General Motors, where millions can be spent on research and development, and the cost passed along to the consumer, but only to those who choose the product. The school must tax all patrons whether or not they are satisfied with the product. Further, the school by now has vast aggregations of operatives (teachers and administrators) who have deep vested interests in the system as it is currently managed, and who provide another thick layer of resistance to any novelty which is perceived as threatening. Therefore, we have a fairly well-frozen concept of what school is and how it should be organized. This has led quite naturally to a relatively rigid conception of what the school should look like and to consequent architectural stereotypy. We have embedded the pupil-teacher ratio in the folklore, and it is thus easy to find the number of cells needed by applying the ratio of bodies to be distributed. Stacking these cells one after another has led to what some describe as an egg-crate structure which sprouts with only minor modification or embellishment from Maine to California.

School As It Might Be

In the face of this rigidity, what is needed is a new conceptual formulation of "school"--one that doesn't depend on customary boundaries--one that doesn't limit "school" ideologically, organizationally, or architecturally. Even if we examine new propositions and come again to the same rationalizations and assumptions about the purposes of instruction, about the grouping of children for instruction, and about the housing of the activity, we may do so in the knowledge that we do these things by design and not simply by cultural repetition. Are we able to think of "school" as an extension of the community and the wider environment; of classes as collections of persons aroused by similar interest or concerns; perhaps even think of "school" without a building? One might formulate "school" as a complete residential, social welfare unit in which the children are entirely removed from the family situation, and in which they are clothed, housed, fed, and given instruction, as in the Israeli kibbutz. Or, at the opposite extreme, one might formulate "school" as managed entirely in the home, with the mother supplemented by television or mobile devices, making the assumption that she or her substitute could be semi-trained and carry on instruction in lieu of organized schools. Her service roles could then be performed at the cost of society at large--cleaning, washing, ironing, feeding.

At the very least, one might formulate "school" as a collection of youth and social welfare activities brought together in one location and representing a life-space reality for much of the child's time away from home. Could one envision a huge plastic dome, with controlled climate underneath, light, changeable structures inside to house instructional activities, year-round outdoor activities, physical education, recreation, libraries, YMCA, scouts, and other youth-serving agencies? Suppose, for example, that forty or more acres could be enclosed, that the light structures, protected from the weather, could be modified as desired to suit differing instructional demands. They might be constructed of demountable, modular panels which could be arranged in a variety of shapes and sizes, easily hooked together, or taken apart, stored and re-used. Much of the ground surface area could be a grid structure enclosing needed mechanical service facilities so that the structures could literally plug in anywhere and be autonomous.

Suppose further, that the school complex includes productive work opportunities, retail shops, service enterprises, light industrial and repair facilities, even residential arrangements for some teachers and students. In addition to expected productive intellectual exercise, there could also be a purposeful reality to the enterprise for the student participants. The complex could in fact be largely run by youth for their own sakes and in avowed competition with adult agencies. This might contribute greatly to an enhanced self-image for the adolescents which is extraordinarily hard to come by in an adult-controlled, adult-focused society. What is needed goes beyond the opportunity to play at democratic forms or to look in on the fringes of productive work--it calls for real engagement in a responsible way with the problems of a relevant society.

Architecturally, such a school complex represents a somewhat different and exciting concept with its year-round climate, new building forms and social organization. What would represent a compelling tour de force, however, would be the fashioning of such an oasis in the midst of metropolitan squalor. Instead of a clean new site and unlimited planning possibilities, suppose that a city street for a block or two could be covered over and a similar kind of green retreat provided. The old buildings on either side could be remodeled and upgraded for use as instructional spaces, and work and supportive service areas, much as predicted in the description of a new setting. True enough, another block or two would need to be razed for athletic and recreational space. The point is to give some locus to youth activity which could engender its own excitement about learning--which could have an immediate application in reality--and which would require a pervasive commitment.

Space Requirements Affected by the New Media

One may safely assume that any transition to a reformulation of "school" will be gradual, and that present structures will not be discarded for decades to come--that built-in conservative mechanisms will operate to continue the system much as we now know it--responding lethargically to innovations, good and bad. If modifications continue to be introduced, however, attention will inevitably be given to their effects on the spaces in the school building. Such modifications and newer media would include organizational devices (individual study, large group instruction, team teaching) and mechanical aids (mass media television, auto-instructional devices, simulation materials, and other audio-visual refinements).

The size and character of instructional spaces will conform in an adaptive manner to changing emphases in the curriculum, or in the organization of the school for instruction. If increased consideration is given to individual study, some sort of private space will need to be provided for each student so engaged. This would represent a home-base study area for the student, equipped so that he could leave and return, have access to information through books, television, tapes, program devices, computers and microfilm. It is unlikely that such a space could be capable of multiple use, and consequently, depending on the program of the school, would probably have a relatively low utilization factor. Such spaces for students imply similar spaces for teachers so that scheduled and non-scheduled conferences can occur about the progress of the independent study. Creation and intelligent use of such spaces also implies a rather large degree of freedom for student and teacher alike.

Conversely, for large group instruction, other types of architectural solutions are indicated. In contrast to the typical ratio of twenty-five students to one teacher, large-group instruction envisions one hundred to two hundred and fifty arranged under the leadership of a teacher who has developed special skills for presentation to large groups. Such an arrangement also requires assembling considerable logistical support: audio-visual aids and television tapes, charts, projection, assignment of roles to teacher and assistants, agreement on the mechanics of discussion, and involvement of other instructional areas. These activities involve additional space requirements for preparation of audio-visual materials--slides, tapes, overhead projector materials (charts, graphs, illustrations)--and for the instructor and assistants to meet together or with students. The character of the meeting space for the large group itself probably would include customary seating and writing surfaces, but in addition, might take advantage of some of the modern gadgetry such as rear projection television, perhaps even individual keyboard and consoles directly connected to computer programs.

Team teaching, if it is to be adequately supported, requires a different kind of space, and considerably more of it, than usual classroom arrangements. One of the assumptions concerning team teaching is that at least two groups at different times come together under the direction of one or more members of the team. This implies that the space involved must be much more flexible, capable of expansion or conversion without major effort. Additionally, team teaching requires someplace for the members of the team to get together to plan their joint activities, arrange for appropriate equipment, keep records, evaluate their progress, and confer with individual students. All told, the minimum space for a team consisting of two groups of youngsters, should include at least two customary classrooms of approximately one thousand square feet each, and probably capable of being thrown together as occasion demands, plus office and storage space, plus some library and project areas, perhaps an additional six to eight hundred square feet.

The major effects of technology and new media on laboratories have been most marked in the elaborate instrumentation of language installations. At the moment, these listening areas are typically grouped in one room adjacent to tape decks and controlled by a teacher and complicated console. Unlike the traditional language room in a high school, the space is limited to a single purpose, which, depending on the size of the school and the variety of its language offerings, may receive relatively low utilization. A more imaginative use of such equipment might be to locate the listening booths around the school in various small areas, some perhaps adjacent to the library, with hook-ups to a central remote tape deck which could be programmed for listening, or plugged in on a regular schedule for monitoring by a teacher.

Libraries, if they are adaptive at all to the incursion of new media will progressively miniaturize the storage of information on microfilm, tape cartridges, and video-tape. Again, as with language laboratories, what is needed is less a space to assemble large numbers of people, but rather a central storage area, from which material can be piped electronically to instruments throughout the school. Microfilm remote readers, i.e., television receivers, could be used to project closed circuit images broadcast from a central source. Even if housed in a single location, places for listening and viewing will need to be provided, and more important, a small efficient system of cataloguing, sorting and retrieving information, probably electro-mechanical, is required.

Having noted these relatively specific requirements for the character of the spaces in the school, we should also note the general impositions of the new media on space relationships. There seem to be two general tendencies: one, resulting from the very nature of the complicated machinery and devices required for mass media reception or closed circuit television broadcast, for example, is to freeze for a single purpose large areas or parts of the structure of the school building; the second, however, which is inherent in the equipment, is the possibility of tying together remote areas of the school at will and instantaneously in a manner which can provide a new kind of flexibility for program and use of space. This latter possibility suggests that some of the relationships posited in the past may no longer be relevant, if we can assume that a walking relationship can be superseded. Within the typical instructional spaces, however, a greater variety of space use will need to be provided for if individualization of instruction is to occur and the new media are to be capitalized on. Again, this introduces the requirement of more not less space. We might visualize one portion of the classroom space with private listening booths, another area for private viewing, another for use of auto-instructional devices including computer systems, another area for storage of some of the hardware, a storage area for student projects, and of course, common areas for group instruction, discussion, and presentation.

Environmental Requirements Affected By New Media

Thermal.--The instrumentation characteristic of the new media, and some of the organizational arrangements characteristic of users of new media, place new loads on the mechanical systems of the school. The instrumentation itself may require critical temperature, humidity, and dust control which virtually necessitates the installation of some sort of air conditioning. Organizational aspects would include the rearrangement of space, movement of walls, furniture and equipment, and children, all of which would place variable loads on the design of the heating and ventilating systems, and new demands on the sensitivity of the control system. All of the typical problems would still remain, the orientation of the space, the radiant effect of solar energy, the effective heat generation of numbers of live bodies, requirements for positive ventilation, and the responsiveness of the system to changing climatic conditions.

Sonic.--School buildings have typically provided the classroom teacher with a kind of acoustical insularity, particularly in the older buildings where the walls between rooms were constructed of heavy masonry. In most cases the teacher could conduct her activities without undue interference from the activities of other classes, and without fear of disturbing others. Some of these acoustical virtues of older buildings have disappeared in the wake of attempts to open up the space, to make it more flexible and convertible, and to lower the cost of construction. For newer structures, and particularly in those programs which contemplate extensive use of the newer media, many of the demands on the structure are incompatible. Much of the instrumentation and hardware require acoustical refinement in the conditioning of the spaces; television origination, for example, makes major demands on auditory amplification, particularly if the intent is to retain the main features of the classroom; some of the programmed devices would require multiple access to power and individual earphone outlets; television viewing requires some variable degree of amplification. Each of these requirements implies a degree of conditioning of the space, which, however, generic, limits the degree to which the space can be converted to other uses, or the degree to which economies can be achieved through structural simplification.

Visual.--For some years now, school planners have paid conscious attention to brightness balance goals within the classroom with the general consideration being that visual efficiency reaches its optimum when the task and its surrounding areas are of a uniform brightness. Commonly accepted brightness balance goals have been defined by the National Council on Schoolhouse Construction:

> In a classroom, the brightness of any surface viewed from any normal standing or sitting position should not be excessively greater than the brightness of the visual task. As the high brightness of surfaces in the visual field approaches the brightness of the task, visual comfort and efficiency increase. Present research indicates that the highest acceptable brightness of any surface in the visual field should not be greater than ten times the brightness of the task.
>
> In a classroom, the brightness of any surface viewed from any normal standing or sitting position should not be excessively lower than the brightness of the visual task. As the low brightness of surfaces in the visual field approaches the brightness of the task, visual comfort and efficiency increase. Present research indicates that the lowest acceptable brightness of any surface in the visual field should not be less than one-third the brightness of the task.
>
> The brightness of surfaces immediately adjacent to the visual task is more critical in terms of visual comfort and efficiency than that of more remote surfaces in the visual field. These adjacent surfaces have lower acceptable brightness limits than surfaces farther removed from the task. Present research indicates that surfaces immediately adjacent to the visual task should not exceed the brightness of the task.

> The brightness-difference between adjacent surfaces in the total visual field should be reduced to an acceptable minimum.
>
> Daylight and electric light systems should conform to the same brightness and brightness-difference goals, and both systems should be coordinated in design to assure the effective contribution of both.

These brightness goals assume an illumination level of from thirty to fifty foot candles on the reference task, a rather modest expectation in view of modern classrooms, which for the most part, suffer from problems of light control rather than insufficiency. The question, of course, is whether or not these goals are still appropriate as mass media devices and other newer media are introduced to the classroom. Despite improvements in projection equipment, including orthicon tubes, some reduction in the illumination of the space is usually more comfortable when the devices are used for mass viewing. If the instructional space is a single-purpose area, visual conditioning is simplified, and concentrated on the solution of a uni-dimensional problem. Most instructional spaces, however, must satisfy a plethora of requirements--different activities, different instructors, and different inhabitants--which are only complicated by the newer media. If close-task, auto-instruction equipment plays a significant part in the program, a relatively high level of illumination is called for at the task surface. This may need to be selectively controlled, since only part of the class may be involved at any one time. Viewing devices may require separate booths, or a darkened area with some visual screen from natural or artificial light sources. What seems clear is that the control and flexibility problems are magnified each time one introduces a larger variety of activities or instruments into the environment.

Aesthetic. --The school building of the future has been caricatured as an Argus-eyed, knob- and dial-bedecked warehouse of gadgetry, with the chill compassion of steely-hued teaching machines as the only solace for a legion of energized automatons. True, some of the hardware seems now unlovely, and hard to hide, and much of the raw newness makes the equipment appear omnipresent and distinctly overbearing. What must be called to mind, however, is that any kind of artistry in the design of school buildings was almost entirely missing less than two decades ago. Even the use of color in school rooms and school furniture has appeared largely since World War II. Only very recently have we begun to soften the harsh, cellular, institutional image of the school--imagine trying to discuss carpeting, draperies, comfortable furniture, indoor-outdoor swimming pools, etc., as short a time as ten years ago. What is probably frightening to many is the thought of possibly eroding the humane gains made in school housing in an effort to be more efficient and productive through the use of the new media. The new media, too, are intended to be intrusive rather than unobtrusive and must consequently be designed around, rather than relegated to ancillary consideration. I suppose that one of the major aesthetic problems is to somehow order the clutter and chaos--and yet preserve what informality, flexibility, and humane amenities the building has come to include. There is hope, I think, in progressive miniaturization which will eventually reduce just the plain bulk and awkward ugliness of much of the equipment. Then too, there is the possibility that through imaginative use of some of the new media the whole concept of "school" may be opened up, and the learning areas spread around a campus or even around a community, and tied together by a network of television and computer communication.

Other aesthetic considerations will come from the impositions of the visual and sonic requirements of the equipment itself and the spaces in which it is put to use. For example, if it is decided that mass media television viewing is most efficiently accomplished in a single-purpose controlled environment like a movie theater, or if it is judged most practical to locate a language laboratory in a single area, then these functions and spaces become relatively frozen, children are rotated in and out of the spaces on a scheduled basis, and the spaces themselves are designed with a single purpose in mind, and treated acoustically and visually to accomplish that purpose. Such a treatment may mean a move away from the relatively light, flexible structures we have come to know recently, to a more rigid, heavy, building with considerably less use of natural light.

Service and Ancillary Requirements of New Media

If a school system, either gradually or by conscious decision, moves in the direction of large-scale use of new media certain kinds of questions must then follow:

1. What shall be done about the storage of the equipment? Should the auto-instructional devices, closed circuit television equipment, etc., be spread around a building or a system--or should they be stored in a central place, available on call, but under the control of knowledgeable technicians? If they are to be located where instruction will occur, what kind of space is needed, and how is the equipment to be inspected for maintenance?

2. What about maintenance? Will contracts be signed with the manufacturers so that their servicemen will be on call? How much "down-time" is there likely to be? Would it pay to hire a full-time television repairman, and some technicians? What about computer maintenance and the use of the computer in off hours?

3. What about access to the media? Are we able to design the new buildings and remodel the old so that we can provide mobility for the equipment and for the users? Do we need to consider ramps, more elevators, wider halls, doors and closets?

4. What about construction features for new buildings? Should floors and ceilings be designed around grid structures so that electrical and other services can be supplied within two or four feet of any spot in the building? Can access be provided in the structure to those fixed installations which require repair? Shouldn't the entire electrical service to the structure be significantly heavier to anticipate future demands? Will it be possible to plan for flexibility, convertibility in the structure, so that newer programs can be accommodated as others drop out and disappear?

Cost Estimates of New Media Applications

As one moves from scrambled texts and simple mechanical devices to the more sophisticated of the newer media, simulation apparatus, responsive environments, computer-based feedback systems, and television viewing and origination equipment, the costs increase. I suspect that these costs, either in initial capital outlay, or in succeeding operational costs per pupil, will increase directly in proportion to the sophistication of the system. True enough, the installation costs should be less for new construction than for old since the conduit and services can be planned for rather than added later, but the secondary costs will probably be the more burdensome. The secondary costs include maintenance and repair, down-time, substitution of equipment, technical management of the equipment when in use, and added costs for closer control of the environment.

No one will dispute that these costs, even if multiplied several times over, are still insignificant in relation to the value of the product, and that society's investment in the enterprise is niggardly in view of the expectations which it holds for the outcome of the process. But what is alarming is the notion to which many tax-conscious groups have fastened that the new media are not only educational panaceas but financial panaceas as well, and that the cost of education can be materially reduced. I'm certain that people will continually seek simple solutions to complex problems, and in doing so will tend to state the problems in simple terms, which then, by circular reasoning, will seem to justify simple solutions. What seems to be more realistic is to view the new media as additional tools for the instructional kit, which may, in skilled hands, produce a more sophisticated product at higher cost.

Conclusion

It does seem obvious from the foregoing discussion that new approaches to the planning and design of school buildings are required. These new approaches should be systemic and systematic. Each introduction of a new device or concept produces a corollary consequence or series of consequences on other parts of the system, some foreseen and others unimaginable. It is possible to order in some fashion the needed space requirements, and to predict with increasing assurance what some of the related productive output will be. Presumably, no one can or wishes to control all the variables in a teaching-learning relationship. A systems approach, however, would remove the predictable relationships, such as the installation of carpeting and consequent different maintenance programs, for example, so that the effort in a planning matrix might fall on the intellectual, philosophical and social implications of new educational arrangements.

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PART IV

THE IMPACT OF THE NEWER MEDIA ON OTHER ASPECTS OF AMERICAN EDUCATION

Chapter
VIII. EVALUATING THE IMPACT OF NEW MEDIA ON HIGHER EDUCATION . . . . Wilbur J. McKeachie

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CHAPTER VIII

EVALUATING THE IMPACT OF NEW MEDIA ON HIGHER EDUCATION[1]

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As college administrators search feverishly for new funds, they vacillate between the relative public relations values of two images--one that of the ivy-clad, traditional, liberal arts college largely populated by absent-minded, eccentric, but well-meaning professors and by eager, inquiring young scholars drinking in words of advice from these venerable saints--the other, a modern, efficient, dynamic institution as up-to-date as the latest Detroit automobile and as efficient in turning out polished graduates as the newest, fully automated factory. The latter image is one with little appeal for faculty but is certainly appealing to those who feel that higher education has failed to progress as rapidly as industry and business. The college president's dilemma is heightened by the question of his trustees, "Can't we save money by using some of the new techniques like television or teaching machines?"

Under such pressures it is little wonder that the newer media have been introduced into higher education in strained circumstances. After several years of extensive trial, can they now be evaluated? Can their future role be predicted? This chapter is an attempt to answer these questions.

The Effectiveness of the Newer Media in College Teaching

To assess the potential impact of new media, we will first review research on their teaching effectiveness. But impact depends not only upon actual effectiveness but also upon the attitudes of students, faculty, and others exerting pressures upon the use of the newer media. Following an assessment of the evidence on these attitudes, we will turn to projections both of the ideal and of the possible impacts of the new media.

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[1] The author gratefully acknowledges helpful suggestions of Stanford C. Erickson, Frank Koen, and Carl Zinn of the University of Michigan Center for Research on Learning and Teaching and stimulating conversations with E. L. Walker and Stephen Kaplan.

Warnings

Some caveats may be in order as a general prelude to our review of relevant evidence. Are comparisons of the teaching effectiveness of new media with conventional teaching methods appropriate?

The current ploy of disappointed advocates of one or another of the much-promoted panaceas for our problems is to say that comparisons between teaching methods are really valueless. I may, myself, have contributed to this diversionary tactic by reiterating the idea that research on more specific variables in the teaching-learning situation might be more productive. Moreover, there are many weaknesses in the typical experimental comparison of two teaching methods. Among these are:

1. Failure to measure important learning outcomes--particularly more complex outcomes such as critical thinking and attitude change.

2. The use of such unreliable and insensitive tests and weak statistics, that the opportunities for invalidating the null hypothesis are slim even if there were a real difference in effectiveness.

3. Inadequate number of instructors if results are to be generalized.

4. Questionable representativeness of the sample of examples of the methods used in the study. For example, in comparisons of programmed learning with conventional textbook learning, no one experiment compares a sample of representative programs and representative textbooks. Lacking this, it would be helpful in interpretation of results if some care were taken in describing both methods being compared in such detail that one might justifiably be able to conclude that a good example of one medium is no more effective than a poor example of some other. In typical studies one of the methods is taken for granted as conventional and left undescribed, and we are left wondering whether or not some slight improvement in one of the methods might have resulted in significant differences.

5. The learning theorist is used to thinking in terms of knowledge of results, sequences of positive and negative instances, patterns

of reinforcement, and other learning variables. The omission of any description of these features of the methods compared leaves him wondering whether similarities or differences in these familiar experimental variables may not account for the results of the experimental comparison.

Despite these inadequacies in much research on teaching effectiveness, that research has one important consequence. It punctures the effervescing bubbles of unrealistic claims for each new medium and forces us to look for the specific tasks which the medium can perform effectively. While ineffective media may well be widely adopted, and effective ones underused, my faith in the basic good sense of college faculties leads me to believe that the most probably impact of the new media will be in those areas in which they are most effective.

Moreover, many of the weaknesses described above are washed out when a large number of studies are carried out. Thus the large number of comparisons of televised and live instruction give us a range of institutions, instructors, subject matter, and criteria which no single researcher could hope to gather, and our conclusion about the relative effectiveness of typical televised instruction can be made with some confidence.

In short, comparative studies of teaching methods are usually of interest to the theorist only as a possible aid in indicating some variables needing more detailed study, but to the administrator or faculty member, research on comparative teaching methods may be of real practical value. It may not matter to him whether or not students really ask questions when microphones are installed in television-viewing classrooms. To the administrator, the important question is whether the microphones facilitate learning. Similarly, he is not likely to be as much interested in differences in reinforcements in classes taught by lecture compared with those taught by discussion. The important thing is that discussion is more likely to result in changes in thinking.

One brief warning with respect to the attitudinal data is also appropriate: the relationship between student or faculty evaluations of teaching effectiveness and actual effectiveness as measured by student learning is not high. Attitudes of students and teachers thus are presented not as evidence of the effectiveness of the new media but rather as indications of the ease or difficulty of their introduction and continued use.

Differences between college and elementary or high schools affecting impact

Although basic principles of learning are valid for all sorts of learning, and the results of educational research in public schools are relevant for colleges, generalization to the college level cannot be blithely assumed. Television, for example, seems to have diminishing effectiveness as one moves from elementary to high school to college (Schramm, 1962).

One of the reasons for caution is, of course, the nature of the learner. The more mature student has a larger vocabulary, better ability to conceptualize and integrate materials, and more thoroughly practiced reading skills. But equally important is the difference in goals between elementary school and college. In elementary school the development of perceptual and sensory-motor skills, such as reading, is an important outcome. In college the emphasis upon higher level cognitive outcomes is much greater. Thus, media effective for less abstract functions are likely to be of greater value in the elementary school than in college.

In addition to differences in the effectiveness of the media at different educational levels, there are differences in institutional organization which affect impact. The college teacher has considerably more autonomy than the elementary school teacher in selecting teaching materials. Thus, while principals and school boards are probably the most important gatekeepers in determining the entrance of new media into public schools, the gatekeepers at the college level are the teachers themselves--a group much less sensitive to public pressure.

Television[2]

The most glamorous of the newer technological aids to education is television. Before reviewing the research on teaching by television, let us consider two hypotheses that may help in analyzing the research results.

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[2] Some of this section was previously published in W. J. McKeachie, "TV for college instruction." Improving college and university teaching, 1958, 84-89, and is used by permission of the publisher, Graduate School of Oregon State University, Corvallis, Oregon.

Television is not a method of instruction in the sense that discussion and lecture are methods of instruction. Rather, it is a means of giving the student a clear view of the instructional situation. Therefore, we would expect that (1) the relative effectiveness of teaching via television will vary depending upon the importance of being able to see clearly. For example, we would expect television to be effective when it is important for students to see demonstrations, visiting lecturers, or films, but to have little advantage when the communication is primarily verbal.

Television reduces the opportunity for students to communicate with teachers and for teachers to interact with students. We would thus expect that (2) the effectiveness of television will vary inversely with the importance of two-way communication not only for feedback to the student but also for feedback to the teacher.

Research at Pennsylvania [illegible]ate University

Since 1954, Pennsylvania State University (Carpenter and Greenhill, 1955, 1958), with support from the Fund for the Advancement of Education, has been studying the effectiveness of courses taught for a full semester over closed circuit television. The results of this research may be used either to extol or damn television. Essentially, they indicate that there is little loss in student learning in courses taught by television as compared with courses taught conventionally. Students learned the information needed to pass examinations, and most did not object strongly to the televised classes although they preferred live instruction.

Factors unimportant in the use of educational television

The heading of this section would normally be "Factors conditioning the effectiveness of educational television," but the results of the research are indicated by the title chosen. The Penn State researchers investigated potentially important conditioners of television effectiveness. The results were consistently negative. For example, recognizing that instructor-student interaction is sometimes important in learning, they installed "two-way" microphone communication in the receiving rooms so that students in the receiving rooms could ask questions. This technique has been used more extensively at Iowa (Stuit *et al*., 1956) and at Case (Martin, 1957). They found that this method of instruction was not superior to simple one-way communication, although students preferred two-way communication. (For similar further results at Case, see Martin, Adams, and Baron, 1958.) Similar results were found in the Army's research on television instruction (Fritz, 1952).

Another attempt to combine the value of interaction with that of television was an experiment in presenting a thirty-five minute television lesson followed by a discussion period of fifteen minutes in each of the receiving rooms. Other students in the same course observed by means of television the fifteen minute discussion conducted by the instructor with the eight students in the origination room. Still other students were allowed to leave or to study their notes. As with the other attempts to provide interaction, results showed no significant differences in test performance between students taught by each of these three methods. A poll of students indicated that they preferred two hours of lecture per week followed by a full period of discussion to a short discussion each period. Size of the viewing groups was also not an important variable in television instruction. Nor did proctors in the viewing rooms contribute to student learning.

The Pennsylvania State research, however, provides some support for the idea that television's effectiveness is in giving the student a good view. In one experiment students who had three weeks of instruction were given their choice of whether to finish the course in television classrooms or in the originating room. Depending upon the course, one-third to two-thirds of the students chose television. The most interesting aspect of this finding was that these students were predominantly those who had been assigned seats toward the back of the lecture hall.

Adapting a course for television by adding supplementary visual aids also proved to be no more effective than televised lecture-blackboard presentations. In fact, both at Penn State and New York University (Adams *et al*., 1959; Klapper, 1958) the "visual" productions tended to be *less* effective than "bare bones" television. Lumsdaine and Gladstone (1958) compared a film with musical and visual embellishments with a plain version in which the learning materials were presented on a plain background and obtained similar results. Experiments with color films have produced a similar lack of support for the added expense of color (May and Lumsdaine, 1958; Vandermeer, 1952), and a study of the relative value of standard equipment versus a visual presentation including only parts relevant to the major part of the lecture showed superiority for the latter method (Aukes and Simon, 1957). It thus appears that visual materials may distract the students from the verbal content upon which tests are usually based. One's general conclusion would be that any additional stimuli contribute to learning only insofar as they have special cue value for the learning desired. Presumed motivational values of visual presentations may not be important in the usual classroom learning situation.

Research at Miami University

A second major project in closed-circuit instruction was that at Miami University (Macomber and Siegel, 1956, 1957, 1960). Miami's research is of particular interest because it compared closed-circuit television with both large lecture classes and small semi-discussion classes, and because the Miami staff studied the possible differential effect of different types of instruction upon students of differing abilities and attitudes.

In Miami's first experiment, the primary measure of achievement was a final examination in each course, and the television classes were not inferior on this criterion. In fact, in human biology the television students scored higher than the conventional classes, although there were other factors that might have contributed to this difference. In a similar study (Syrocki and Wallin, 1962) significant differences were not found. But in the second year of telecasting, live teaching produced greater achievement than did television in the second semester of the four courses, and in economics it proved to be superior in producing gains in critical thinking. Results of third-year experiments were less damning to television, although television classes in zoology proved inferior to conventional classes on a test of problem solving.

Since television is usually considered as a substitute for large classes, it is worth noting that large "live" classes did not consistenly produce the inferior results of television in the cognitive outcomes, but did tend to be inferior to conventional classes in effecting changes in attitudes.

Other experiments in college teaching by closed-circuit television

Among the largest and best-designed of other experiments on television teaching were those carried out in Purdue, Iowa, New York University, San Francisco State, and Oregon. Although these experiments have already been cited where relevant in our discussion of the Penn State and Miami experiments, a few points remain. One of these relates to the teaching of English composition by television. Even though the Purdue experiment (Seibert, 1958) used television for only two of the three instructional periods per week and television students apparently had a good deal of practice in theme writing, television instruction proved to be significantly inferior to conventional instruction in several comparisons. New York University also found evidence of superiority of conventional methods as measured by theme writing. Similar differences favoring conventional instruction using objective tests of achievement were found during the first semester but reversed during the second semester.

Purdue also found television instruction to be inferior to conventional instruction in mechanical engineering (Seibert, n.d.), military science (Kasten and Seibert, 1959), and, on some tests, in calculus (Seibert, 1957).

When a course demands the demonstration of small objects or parts, the use of television or film should be advantageous. In an experiment at Rensselaer Polytechnic (Throop, Assini, and Boguslavsky, 1958) in teaching a course called "Strength of Materials," television was not inferior to conventional methods of teaching instrumentation and specimen behavior, but was inferior in teaching theory and familiarity with machinery.

A unique study by Insel, Schlesinger, and DesRosiers (1963) used the critical incident technique to support the conclusion that student responses to effective televised instruction tended to be other-dependent while responses to effective conventional instruction tended to be self-dependent.

Uses of television

From our hypothesis that television would be of most value in courses depending upon visual presentation of information, we might expect it to be more effective in science and engineering courses than in social sciences and humanities courses. From our hypothesis that television would be of less value in classes where interaction between students and instructor is important, we might expect it to be relatively less effective in psychology, speech, and languages than in courses usually taught by lecture. Such comparisons are difficult to make, however. As we have seen, in general psychology courses both at Purdue and Penn State, television students did more poorly than students in conventional classes. In English, too, television proved to be inferior. This evidence is in line with our hypothesis.

Insofar as student-instructor interaction is important for teaching a course, television would appear to be of little help. Television does not permit more students to talk, even with two-way audio connections. It is apparent that the student's opportunity to participate is an inverse function of the number of students in the class. If actual participation is important, larger classes should be less effective, whether they are taught in one classroom or by television.

Television can, however, have certain advantages in promoting interaction. On any large college campus one of the difficulties in education outside the classroom is that students have few common educational experiences. Since their common experiences tend to be social or athletic, these are likely to be the usual topics of conversation. Stephens College (1955) met this problem in a creative way by developing a required course--"Ideas and Living Today"--which consisted of brief lectures viewed by students in small faculty-led discussion groups. The course was craftily scheduled just before lunch so that discussions spilled over into the dining halls.

Let us look at our hypothesis that television will be effective when a good view of the instructional situation is important. Television was effective in teaching dentistry (Grossman, Ship, and Romano, 1960). As we have seen, students learned as much by television as in conventional classes in chemistry both at Penn State and Purdue. If we simply look at the direction of the differences, about half the experiments in science classes favor television and half favor conventional instruction. In non-science courses well over two-thirds of the differences favor conventional teaching.[3]

It seems safe to conclude that television instruction is inferior to classroom lectures in communicating information, developing critical thinking, changing attitudes, and arousing interest in a subject, but that this inferiority is probably not great. Although differences favoring conventional teaching appeared in about two-thirds of the studies reviewed, only a fifth of the differences were statistically significant. Schramm's review (1962) similarly reports three college-level studies in which television was significantly superior and thirteen in which it was significantly inferior. One's view of these results depends a good deal upon one's bias toward or against television. When compared with research comparing other instructional methods, the consistency of results favoring conventional instruction over television is unusual. However, when one weighs heavily the necessity for accommodation of higher education to large numbers of students, the differences between television and conventional instruction seem relatively small.[4]

Films

There is probably no essential psychological difference between television and films. Even though most of the great mass of research in instructional films has not been concerned with college teaching, it is relevant to our topic. Although it would be impossible for us to summarize all of the studies, certain principles have emerged. (For a more complete analysis, see Miller, 1957.)

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[3] Note that the tests used in most studies are verbal. In any course where visual identification or discrimination is an important goal, we might expect a visual test item to be more valid. While many of our goals primarily involve abstractions and verbal or symbolic concepts, our tests may underrepresent goals involving learning to deal with the real world of objects and events.

[4] The preceding comments have been primarily concerned with closed-circuit television instruction on campus. Although it is difficult to do adequately controlled studies of the educational effectiveness of broadcast television, it seems quite clear that students motivated enough to take a television course for credit at home will learn well and have favorable attitudes toward television (LePore and Wilson, 1958; Dreher and Beatty, 1958; Evans, Roney, and McAdams, 1954).

1. Students can learn from films, and usually do learn at least as much as from a poor teacher (VanderMeer, 1950).

2. Such learning is not confined to details, but may include concepts and attitudes (Kishler, 1950; Mertens, 1951; Hoban and Van Ormer, 1950).

3. Outline materials such as titles and commentary increase learning if a film is not well-organized (Northrop, 1952).

4. For less intelligent students, repeating the film increases learning (McTavish, 1949).

5. Students learn how to learn from films; i.e., students with previous experience with instructional films learn more than students without previous experience (VanderMeer, 1951).

6. Presenting pictures is more effective than presenting words as stimuli in rote association tasks such as learning a foreign language (May and Lumsdaine, 1958; Kopstein and Roshal, 1954).

7. Participation increases learning (Hovland, Lumsdaine, and Sheffield, 1949). In this study, active response with prompting and feedback was most effective on the most difficult material with the least motivated, least able students--a finding which probably has wide generality in teaching (also see Michael and Maccoby, 1953, 1961). However, Ash and Carlton (1951) found that note-taking during a film was not effective when a test was administered immediately after the film. This suggests that active participation needs to be planned in the production of a film or television presentation, rather than being interjected as an additional task for the student.

The earlier discussion of instructional television is also relevant to teaching by films.

Tests and Programmed Instruction

Although we usually think of tests in terms of their validity as measures of student achievement, it may be that their function as instruments for promoting learning is even more important. After dismal recitals of nonsignificant differences between differing teacher methods, it is refreshing to find positive results from variations in testing procedures.

In some of the earliest experiments in this area Jones (1923) found that immediate testing after a psychology lecture resulted in improved retention. The good effects of testing persisted or increased over an eight-week period. Jones' results supporting the value of immediate feedback are supported by an experiment in a government class (Fitch _et al_., 1951) in which students having weekly non-credit quizzes made better scores on monthly tests than a non-quizzed control group. Similarly, in a remedial English course at Purdue (Maize, 1954) students who wrote forty themes evaluated in class made greater improvement on a test of English usage than did a group that had workbook drill and wrote fourteen themes, individually corrected by the instructor. Similar results were reported in the study of Guetzkow, Kelly, and McKeachie (1954). May and Lumsdaine (1958) report that learning from film is also positively influenced by participation and feedback devices.

Tests provide knowledge of results, one of the major elements in learning, and we would expect that the more information contained in the knowledge feedback, the greater its value. In an experiment in the Air Force (Stone, 1955), performances benefited from return of multiple-choice tests with information about why the alternative chosen was wrong, as well as why the correct alternative was right. This technique proved superior to four other techniques which gave less complete knowledge of results ranging down to returning only a score on the total examination. Similar results were obtained by Bryan and Rigney (1956), and by Briggs (1961). In a related study McKeachie and Hiler (1954) found that students required to answer study questions performed better on test questions in the same area than did students not given the questions, and that the former also tended to do better than those whose answers were not required or graded. Thus, the simple principle that knowledge of results facilitates learning is one of the few generalizations clearly supported by research on college teaching.

The bridge from tests to "automation" is found in the work of Pressey (1926, 1950) and his students who have published the results of an extensive program of research with tests that students score for themselves by choosing alternatives until they hit the correct one. Four types of studies were carried out, and Pressey concluded that:

> . . . (a) the self-scoring characteristics represent a tremendous saving in time; (b) test taking is transformed into self-instruction by the immediate knowledge of mistakes; (c) supplemental use of the test improves performance on regular objective tests; and (d) even more automatic self-scoring devices can be devised.

Pressey's last conclusion proved to be prophetic, for there are now many models of "teaching machines." The teaching machine is a device for presenting text and test questions in predetermined sequences and providing immediate knowledge of results to an active learner. Typically, teaching machines permit the learner to proceed at his own rate. The successive questions proceed in tiny steps from the simple to the complex. If a student makes a series of correct responses, he may adjust the machine to skip some steps. If he fails items, they may be repeated. The program of the lesson may include hints or other guidance. Thus, teaching machines or programmed workbooks have several theoretical advantages over lecturing or other conventional methods of instruction.

There have been two general types of approach to the use of teaching machines. In the early investigations of Pressey and his students the teaching machine was used primarily as a device to provide prompt knowledge of results of conventional testing procedures. The teaching machine was thus simply a supplement to the conventional teaching methods, such as lectures, discussion, and textbook assignments. The second approach, originated by Skinner and his followers, uses the teaching machine as a substitute for other teaching methods; the teaching machine is used either as the sole instrument of instruction or at least as a major method which may be supplemented by the teacher. In some cases the "program" (the series of questions or statements presented to the student) is presented in text or workbook, and "programmed instruction" is now used to refer to any carefully sequenced presentation whether by teaching machine, book, lecture, film, or television.

There is some research evidence supporting the use of teaching-testing machines as supplements to conventional instruction. In addition to the early work of Pressey, Angell (1949), found that immediate knowledge of results on a quiz administered by a punchboard was more effective than delayed knowledge of results when IBM answer sheets were returned to students at the next class meeting. Using a chemically treated answer sheet to provide immediate knowledge of results, Peterson and Peterson (1931) obtained similar results. Stephens (1953) also obtained better achievement both on items covered on the punchboard tests and on new items.

Using Skinner's approach, the experiments of Holland (1960), Oakes (1960), Geller (1963), Hough (1962), Lewis (1961), Ferster and Sapon (1958), and Lawson, Burmester, and Nelson (1960), indicate that students can learn from self-instructional devices much of the material covered in typical end-of-course achievement tests when the program is used as a major source of information. However, Wulff and Emeson (1961) reported that in learning the names of electrical circuits, students did better studying by themselves than in learning from a structured program, and Zuckerman, Marshall, and Groesberg (1961) report similar results.

A good deal of research has been directed to the problem of the role of response in programmed instruction. Does the student need to write out responses? Can he simply be asked to think the correct answer? Is a response necessary at all? Does a programmed presentation have any advantage over a textbook?

The form of response made to the question does not seem to make much difference in the sort of learning required in a psychology course (Coulson and Silberman, 1959). Constructed responses, however, produced superior retention on paired-associate materials in an experiment by Fry (1960), but took more time. However, even when students were required to take the same time, constructed responses produced better results than multiple-choice responses. With meaningful learning (such as logic), constructed responses do not appear to be superior to multiple-choice or true-false modes (Coulson and Silberman, 1960; Zuckerman, Marshall and Groesberg, 1961).

Learning associations through programmed materials is likely to be facilitated when the student is cued or prompted to give the correct answer. This is particularly helpful when the prompting helps the student avoid a common error (Kimble and Wulff, 1961). An experiment by Angell and Lumsdaine (1961) indicates that prompting should not occur on all trials.

In terms of the classic studies of Gates (1917) on self-recitation we might expect active responding to be less important for meaningful prose than for rote-learning tasks. Thus, we would expect constructed responses to be more valuable on tasks like that used by Fry than on the text materials used by Coulson and Silberman, and the results are as expected. Constructed responses thus are probably most valuable where the goal is learning a particular, discrete response. Since much college learning is of more meaningful general concepts, constructed responses may be less necessary. In fact, overt participation may be detrimental when it interferes with reception of instruction or arouses anxiety, as in a rapidly paced presentation (Evans, Glaser, and Homme, 1959; Michael and Maccoby, 1961; Kanner and Sulzer, 1961; Evans, 1960; McGuire, 1961).

Little research has been done to determine what kinds of students learn well or poorly from teaching machines. We might expect that the practice of writing programs so that every question is answered correctly by almost every student would be boring to most students, particularly to those with strong achievement motivation. Atkinson's research (1958) shows these students as being most highly motivated in situations where success is uncertain.

Computerized teaching machines seem more likely to make significant contributions to college education. Using the computer's large memory capacity, the program can be truly individualized and the much publicized tutorial aspect of programmed instruction can be realized. (As an aside, let me point out that the conventional linear program is not individualized except for the learner's choice of the speed at which he will answer. Conventional texts offer much greater individualization.) With a computer each student can be given an instructional sequence chosen to fit his own style of learning, motivation, and error pattern. The computer can adapt to the individual learner much as a teacher adapts in tutorial conversation with students (Uttal, 1961). A modern computer can store the information contained in dictionaries and texts; it can receive input from typewriters, and can present questions or information in the form of typed responses. It can, with appropriate auxiliary equipment, teach a number of students at once. Used with textbooks, computers combine virtues of books and frequent testing.

In view of the research to date, what should an ideal teaching machine and program be like? One characteristic we would want would be that it would facilitate rapid learning. Research indicates that learning progresses more rapidly when the student is not required to make an overt response (Evans, Glaser and Homme, 1959; Roe and other, 1960; Hughes, 1961; Silverman, 1960) and when material is presented as connected discourse or statements, rather than as separate questions and answers. A second desirable characteristic is that the machine should provide opportunities for review and skipping ahead when the learner needs them (Coulson and Silberman, 1960; Coulson and other, 1961; Newman, 1957). A third desirable characteristic would be that the teaching machine provide opportunities for presenting supporting details, evidence, examples, and other aspects of the learning context.

When we examine these criteria, it becomes apparent that they describe the major characteristics of conventional books, and some research supports the superiority of books as compared with present-day programmed instruction (Zuckerman, Marshall and Groesberg, 1961; Follettie, 1961; Pressey, 1964). In fact, despite the preponderance of Skinnerian programs in the current teaching machine boom, research evidence seems to lie on the side of the somewhat less radical Presseyan approach of using questions as adjuncts to conventional textual materials. Nevertheless, there are probably some tasks which can be done well by programmed materials. Higher education has many kinds of goals, and a technique suitable for achieving one may be inappropriate for achieving others. Present day programmed instruction probably is in the Model T stage as compared with its potential.

Language Laboratories

One of the most widely used new devices in higher education is the language laboratory. Developed in the Army intensive language training programs of World War II, language laboratories multiplied rapidly in the post-war years and boomed under the financial impetus of the National Defense Education Act of 1958. The core of the language laboratory is the tape recorder, and as Carroll (1963) has noted, "This device can present foreign language sounds and utterances with accuracy, fidelity, and endless patience and do so with great flexibility and ease of handling."

With its emphasis upon prepared recorded sequence of stimuli with frequent opportunities for student responses, the language laboratory has close kinship to the programmed learning movement. Language laboratories are now an accepted part of the college scene, and I thus was amazed to find no experimental tests of their value as I prepared this chapter. Although there are reports of experiments being undertaken, I could locate no published controlled experiment on the value of language laboratories in college. One study in a senior high school class found that students who had the benefit of a language laboratory did more poorly in reading, vocabulary, and grammar than those without the laboratory experience (Carroll *et al*., 1959).

Printed Materials

One of the newest developments in higher education has received much less publicity than television and teaching machines but probably has more long term significance for higher education. This is the revolution in the use of printed materials, such as paperback books, off-prints of journal articles, facsimile or microfilm copies, and other duplicated materials.

As indicated in the section on teaching machines, one of the newest developments in textbook construction is the "programmed textbook," an instructional book developed by utilizing the learning-in-small-steps sequence of the conventional teaching machine. Such books and booklets are often designed as adjuncts to normal teaching materials. Programmed books may combine some of the advantages of conventional texts with those of teaching machines.

As a result of the revolution in techniques of presenting, reproducing, marketing, and circulating printed materials, not only is the student now able to own a richer variety of resources, but the new open stack libraries invite him to go beyond his assignments to books and journals giving other viewpoints and additional information.

An early study (Greene, 1928) found that students learned as well from reading material as from listening to the same material read aloud. The better students, moreover, profited more from reading than from listening. Corey (1934) found better immediate recall for reading than for a lecture, although the difference disappeared on a later test.

A number of studies have compared printed materials and lectures with results favoring print, at least with difficult materials. (For a review of these studies, see Hartman, 1961.) However, the amount of research on books or articles as media for teaching is remarkably small considering their widespread use. There have, however, been studies of size of print, readability, and the effectiveness of illustrations. (Illustrations apparently don't contribute much to learning as measured by conventional tests.)

In discussions of the remarkable values of bringing "Master Teachers" to all learners through television, we often overlook the fact that through books and printed materials the student can follow not only the teaching of a master teacher, but can actually choose from a number of master teachers the one who best communicates with him.

Photographs, Transparencies, and Other Visual Aids

Photographs can hardly be included among new media. Yet recent years have seen some innovations in their use in teaching. Novak (1961), for example, used labeled photomicrographs in teaching botany.

Antioch College (1960) used acetate visuals projected with an overhead projector, coupled with a language laboratory to achieve substantial savings of instructional time and improve instruction as measured by a test of reading ability. Similarly, Chance (1961) found that the use of overhead projected transparencies and overlays was significantly superior to conventional instruction (using the blackboard) in teaching descriptive geometry to freshmen engineers.

One experiment in the use of tape recording and visual displays in place of face-to-face lectures in teaching introductory psychology indicated superiority of the conventional method (Johnston, 1961). In another study (Popham, 1961) no significant difference was found.

On the audio side of audio-visual devices, two experiments report on the use of telephones in college level instruction. One experiment compared the effectiveness of teaching psychology in face-to-face groups and by telephone (Cutler, McKeachie, and McNeil, 1958). Both groups showed significant learning and attitude change, and there was no significant difference in the two methods' effectiveness.

In the second experiment (Burkhart, 1961) Stephens College classes in philosphy, literature, business education, and American government supplemented their usual instructional methods with amplified telephone interviews with significant people. The results were not startling, but indicated probable value for this imaginative use of the telephone.

Experiments using radio as a communication medium report learning equal to that of face-to-face instruction. Thus, if economy in instruction is desired, perhaps the expense of television cameras and receiving tubes is unnecessary. One of the few experiments comparing the effectiveness of radio and television, however, showed better learning and retention for television (Paul and Ogilvie, 1955).

An unique study by Newman and Higland (1956) suggested that mass media may be more effective in information-giving early, rather than late, in a course. In the course, "Principles of Radio," they compared

1. presentation by tape recordings and workbook,
2. presentation by supervised readings,
3. presentation by tape recordings and slides, and
4. instructor presentation.

The three mass media methods were as effective as the instructor for the first two-thirds of the course but less effective in the last third.

From the use of computers in storing and retrieving information for teaching machines it is but a step to the use of computers in general information storage and retrieval systems. Any discussion of new media in higher education must take account of the tremendous problems faced by college libraries in coping with the rushing torrent of scholarly publications. The federal government, private foundations, colleges, and industry have been studying possibilities of electronic libraries in which students and scholars would be able to get needed information almost immediately simply by querying a computer. In some of the projected systems, students in study stations would have access to printed materials, video tapes, films, sound tapes, or television. The potentialities of such systems are exciting and one may dream of the day when each college will be hooked into a large nationwide computer system which will make available to each college all available information.

This somewhat medieval conception of a single repository of all knowledge is as yet visible only in broad outline, and the technical problems of coding and retrieving are still far from solution. But even in the near future students on some campuses will by dialing in lectures, educational films, teaching programs, and other educational materials.

Student Characteristics

Do certain types of students learn well from particular media? Are some students "visually minded," so that they do particularly well when visual representations are used?

One is tempted to answer such questions with an immediate "Yes," and this answer is probably right. But the amount of research on these problems is scanty.

Lumsdaine, Sulzer, and Kopstein (1961) found that repetition produces greater gains for bright students than for the poorer students.

However, the poorer students, as one would expect, needed more repetitions and examples to achieve the same accuracy as the brighter students.

Student ability generally does not make a difference in the relative effectiveness of television. At Miami low-ability students in "Foundations of Human Behavior" and "Government" achieved more in conventional classes than in television classes. The high ability students was not affected adversely. In view of the more deterimental effects for low ability students, it is surprising to find that it is the brighter students who have the more negative attitudes toward televised instruction.

In English classes at Purdue, the superiority of conventional teaching was most marked for the students of lower ability. New York University did not find similar differences in ability level difference in English. There was some indication in the study by Gordon, Nordquist, and Engar (1959) at Utah that students of high ability learned to use the slide rule better with televised instruction than with conventional instruction, while low ability students did better in the classroom. In a calculus class at Purdue, no ability differences came out. (Dyer-Bennet, 1958).

A number of experimenters have reported no correlation between intelligence and achievement in programmed instruction, although bright students apparently are likely to complete the program sooner. Since achievement and intelligence are positively correlated with most instructional methods, this finding implies that programmed learning is less effective for bright students than for less intelligent students. Although this result may simply be due to the use of achievement tests with insufficient sensitivity at the upper end to assess individual differences in learning, an early experiment with Pressey machines reported best results with the poorest students (Little, 1934).

To sum up, we know very little about how to match students and media. The one implication which emerges is that lower ability students require more feedback either through conventional small classes or teaching machines.

Attitudes toward New Media

Student attitudes

The attitudes of students toward the new media are a mixture of anxiety, curiosity, and resentment. Although negative attitudes are dominant, there are some differences in reactions to different media.

Television. As indicated in the preceding discussion of research on teaching effectiveness, students do not like courses taught by television as well as those taught by "live" teachers (LePore and Wilson, 1958; Macomber and Siegel, 1960; Dyer-Bennet and others, 1958; Bobren and Siegel, 1960). Their attitudes, however, are conditioned by other factors.

At Penn State (Carpenter and Greenhill, 1958) students in psychology were asked how much they liked psychology and how much it contributed to their education as compared with other courses they were taking. On both counts, ratings of the students in the television classes were lower than those of students who were in the same room as the instructor. The psychology students were also asked if they would like to take another semester course in psychology. About the same percentages signed up in all three types of classes, but when asked if they would prefer taking the course in a large class or by television, a plurality preferred television. In this and other courses at Penn State, attitudes toward television were more favorable if students had had television instruction in small classrooms. The Penn State studies were unique in using actual choices as well as verbal opinions.

The generalization that students do not like televised instruction may also be tempered by some indications that student attitudes toward television tend to be less unfavorable in courses in which demonstrations or visual aids are commonly used, such as physical science (Starlin and Lallas, 1960; Erickson and Chausow, 1960). However, in such courses high ability students are significantly less favorable to televised instruction than are low ability students (Macomber and Siegel, 1960).

Both in large lectures and in television sections, students complain of lack of contact with the instructor, but Miami students dislike television less than large lectures, while New York University students tend to prefer lectures. The attitudes of both groups toward television tended to become more negative during a second semester of television. (This seems to be true in several studies.) If they could have the same instructor, students would generally prefer a small section to television or a large class, but they would prefer television or a large class to a small class if they could be sure of an excellent instructor in the television or large class, and had to take their chances in electing a small class. This probably is a pretty realistic alternative, although the student's choice may not always be wise, for, in three experimental comparisons at Miami, graduate assistants proved to be superior (as measured by student achievement) to regular staff members in one course although they proved inferior in another. Moreover, the students taught by graduate assistants did more outside reading.

At Iowa (Becker, 1958) favorable student attitudes toward televised instruction apparently resulted from the opportunity provided for student participation through the use of a two-way communication system. And students do prefer "live" television to kinescopes or films.

One might expect student negativism to change as television becomes more routine. Over the four years of the Miami experiment, however, there seemed to be no significant shift in student attitudes toward televised instruction (Macomber and Siegel, 1960). Bobren and Siegel (1960) report similar findings at Illinois.

Attitudes of students toward the media are probably not a direct measure of their educational values. Studies of student attitudes toward teachers (Elliott, 1949), films (Twyford, 1951), and television (Macomber and Siegel, 1957), indicate only small relationships between "liking" and learning outcomes.

Programmed learning. Published reports of student attitudes toward programmed learning are favorable. Angell (1949) reported that the majority of students favored punchboard administration of tests. Holland (1959) reported that 60 per cent of his students felt that programming made the text easier to understand.

Other audio-visual aids. Chance (1961) reports very favorable attitudes of both students and faculty toward the use of the overhead projector in teaching descriptive geometry. Johnston (1961) reports negative attitudes toward tape recorded lectures.

Attitudes of students: A summary. Studies to date indicate that students are conservatives in the field of educational change. They do not gladly embrace the new technologies. On the other hand, there does not seem to be substantial student resistance to innovations. In fact, one would expect from theory and present evidence that negative attitudes toward new media are likely to be greater while experimentation is going on than in situations where the new media have become a normal part of the college scene.

Faculty attitudes

The spectre of technological unemployment seems far from college teachers today. Yet the college professor's reaction to automation is not greatly different from that of his blue-collar contemporary. College teachers, however, express their concerns in terms of loss of educational values or even of potential threat to the whole fabric of higher education.

As one might expect from dissonance theory, those who have taught by television become more favorable to its use in higher education, but there is a good deal of resistance to instructional television among college faculties generally (Starlin and Lallas, 1960; Stuit, 1957; Carpenter and Greenhill, 1955, 1958; Evans, Smith, and Colville, 1962).

Faculty members who have taught by television generally feel that students learn the basic concepts satisfactorily in a television course, but express doubt about the ability of televised courses to achieve higher level objectives, such as critical thinking and attitude change (Macomber and Siegel, 1960). Among faculty members leading discussion sections associated with a televised lecture in the Oregon experiments, a majority were willing to continue televised instruction in courses in chemistry, literature, and

American history, but a majority also opposed continuation in English composition and in education. Generally, they were dissatisfied with their own role (Starlin and Lallas, 1960).

Although the use of television generally has proved to be more effective in the sciences than in other fields, at Iowa faculty members in the natural sciences were the most opposed to the use of television while those in social sciences were least opposed (Becker, 1958).

At the University of Houston the most elaborate study of faculty attitudes toward instructional television showed that faculty resistance to television was reduced when a video tape recorder was introduced as a technique for recording and improving teaching (Evans, Smith, and Colville, 1962). Another interesting finding was that faculty members favorable to television were more variable in teaching techniques, more interested in research, more experienced, more tolerant of students, less puritanical and less concerned about economic rewards of teaching than those strongly opposed to instructional television.

Thus far there seem to be no systematic studies of faculty attitudes toward programmed learning. Since preparation of programmed materials requires both courage and persistence, reports by individual professors who have written and used programs have usually been full of enthusiasm. Thus far this enthusiasm does not seem to have been communicated to many faculty colleagues.

In the midst of the widely publicized spread of educational television and teaching machines throughout the land, educational films and educational radio, far from being displaced, have displayed remarkable vitality, which undoubtedly indicates some faculty support. However, I have found no systematic studies of faculty attitudes toward them.

Faculty attitudes: A summary. Except for the minority of faculty members who have been actively involved in preparing materials for and using the newer teaching media, faculty members seem to be distrustful of their value. Much of this may be a generalized negativism toward the image of automated teaching rather than concern about specific uses of the new media.

In any case these negative attitudes are important considerations in predicting the immediate future of the new media.

Attitudes of administrators, alumni, and the public

Favorable attitudes toward educational innovations are widely expressed in public utterances of administrators and other individuals concerned with higher education. There is no doubt that some of the enthusiasm has come from administrators hard pressed to find funds for their institutions and from businessmen aware that expanding college age populations will almost inevitably mean higher taxes for the support of public colleges and universities. Whether or not this enthusiasm is economically justified is not a major concern of this chapter. Seibert (1959); Paden (1962); and Carpenter and Greenhill (1958) indicate that television costs are less than conventional costs if more than two hundred to three hundred students are involved, although variables such as instructor salary obviously affect the break-even point. It seems likely that the newer media will not permit dramatic decreases in educational costs, and there may thus be some disillusionment and frustration among those concerned about educational costs.

The Ideal Role of New Media

How should the new media be used in the college of the future? Will the instructor be outmoded? Let us look at each medium in turn.

Film is valuable for its ability to present information visually. Because college students typically come from the top half or two-thirds of the population in verbal and conceptual ability, most concepts can be communicated verbally and visual experience is probably less necessary than in the elementary school. Nevertheless, the college student sometimes may learn more readily when verbal presentations are supplemented by visual ones. When visual discrimination is integral to achievement, as in some of the biological or geological science courses, films and still photographs may be a very economical substitute for direct experience, and may, in fact, permit the student to see things that he could not see directly.

Sometimes films can present data which cannot be abstracted easily and meaningfully in words and numbers for someone who has not seen the phenomena.

Although films are usually thought of in connection with large group instruction, many films are excellent tools in small groups in which film may be interrupted for discussion. By providing a dramatic common experience they may stimulate a higher level of interaction than would be attainable by other methods. By giving varied examples the film may provide a basis for induction of concepts and generalizations.

The chief differences between films and television seem to be in the greater mobility of movie cameras than of television cameras, the greater expense of producing a film than a television lesson (assuming that the television equipment is already available), and the presumed greater immediacy of "live" television. Unfortunately, we have very little evidence on the educational importance of immediacy. Intuitively, it would seem that students would feel more involvement in watching a television professor on their own college's staff, knowing that they are seeing him at the actual moment of performance, than they would feel in watching a film made at some earlier time. Whether or not such differences in involvement do occur (and if they occur whether it makes any difference educationally) is still unknown.

Both films and television permit enlargement so that students can see cellular multiplication, dental and surgical techniques, or small moving parts of an engine. Television and films also enable students to look over the shoulder of a researcher or practitioner and observe his activity without interrupting or disturbing him.

Films and television also permit the individual to see himself in action. Television recordings of teacher trainees, for example, may be used in providing feedback. Unfortunately, research on such techniques is lacking and what we have is not strongly encouraging. Hunter College (Schueler, Gold, and Mitzel, 1962), for example, found no significant advantage for teacher training, using televised recordings for observation and feedback with and without supervisor comments, as compared with conventional verbal feedback from an observer. Results were also negative in experiments by Rumford

(1960) and Tompson (1960). Nevertheless, it seems likely that television can become a useful resource not only in training teachers for public schools but also in training college teachers themselves (Evans et al., 1962). For example, in one teacher training program, television is used to simulate the classroom.

Television may also be of much value in situations where highly qualified instructors or expensive facilities are lacking. In such situations the great burden of coordinated course planning may be justified by the opportunity for sharing an outstanding lecturer among several colleges, with local staff members handling discussion sections, as in the experiments in the Oregon System of Higher Education (Starlin and Lollas, 1960). In most regions, however, flexibility of planning, differences in student populations, and cost suggest that the use of films would be a more elegant solution to the lack of instructors.

Because remedial teaching must deal with a wide range of individual differences in background deficiencies, special abilities, and motivation, computerized teaching machines are likely to be necessary if the teacher of college freshmen is to be relieved of any substantial portion of the instructional load. The computer of the future will not only be programmed to diagnose quickly the nature of a student's deficiencies, but may also be programmed to diagnose other individual characteristics affecting the individual's style of learning (if we ever learn what to look for). Ramo (1957) has suggested that the teaching machine of the future will also store each student's educational records, so that his educational program may take account of intelligence, experience, and demographic variables as well as the pattern of his past learning on the machine. The computer will also be able to respond to feedback as to the student's motivation, and will adjust the learning materials in accordance with individual differences and variations over time in motivation. Programming techniques will provide more and more varied types of programs--some effective primarily for teaching basic facts or principles, but others effective for teaching difficult esthetic or critical discriminations, analytic skills, problem solving abilities, and even creative approaches to problems. The teaching machines of the future will not only have much greater flexibility in program and sequence, but will also have available a variety of stimuli and response modes. While verbal materials are likely to be dominant in most learning programs, in some courses the teaching machine will have available visual and auditory stimuli, and will be able to respond to the verbal, written, or complex motor responses. In fact, the machine may also utilize autonomic responses through measures of basal skin receptance or other physiological measures. Display of stimuli and type of response required will vary both with the objectives of teaching and with the learner.

Note that these suggested uses of film, television, and teaching machines are primarily supplementary to instruction by teachers, rather than replacing the teacher. This is an intentional emphasis. The instructor will continue to play the major role in education. But to know what the best instructor-media combination may be, we need to answer such basic questions as:

What aspects of college education require interpersonal contacts?

In the event of shortage of teachers, what aspects of present teachers' roles can be adequately replaced by use of new media?

How much can information-transmitting be separated from affective processes?

In relation to these questions, let us examine the contributions of the instructor in relation to potential contributions of the new media.

The lecturer

Probably teachers spend more time lecturing than in any other role, and teaching machine advocates have directed their strongest attack at this aspect of teaching. If we look at teaching from the standpoint of providing continuous feedback to the learner, lecturers must be pretty inefficient. Hebbian theory would predict that relatively fresh ideas would be motivating, but that experiences which are too far removed from the student's past experience would produce anxiety (Hebb, 1949). This suggests that the organization of materials should be of great importance in learning. Here it would seem that the teaching machine should have advantages over the lecturer, for the sequence can be carefully planned to utilize our best research on the method of successive approximations, on concrete to abstract sequences in problem solving, and on building up generalizations from varying specifics. Lecturers, on the other hand, vary greatly in the degree to which their materials are systematically organized. Probably few lecturers use optimal sequences of presentation. Moreover, the learner in a lecture is usually passive. Many studies of different types of learning and concept formation demonstrate that active learning is more effective than passive learning (Ebbinghaus, 1913).

Because the lecture provides little feedback, because the sequence of presentation is not always optimal, because the student is passive, and because lectures provide little direct concrete experience, lecturers may be inferior to other media in certain situations involving the lower level cognitive objectives. If instructors become extinct, I suspect that the portion of their habitat from which they first disappear will be the lecture hall. But the chief competitor of the lecturer is not the teaching machine, television, or film, but rather a much older invention, writing. If rate of transmission of knowledge is important, a good book is hard to beat.

Even though printed materials have been almost as popular as television for a much longer time, lectures have survived. The advent of picture-book textbooks didn't dislodge the lecturer. If we'd stopped to think about this, we probably wouldn't have been surprised that millions of dollars haven't had much impact upon lecturers' attitudes toward television.

Perhaps the arguments for the lecture are rationalizations, for there's little research to support them. Nevertheless, I suspect that we psychologists have underestimated important factors in our analysis of learning situations. Because we wish to maintain good experimental controls, rate and sequence of presentation are carefully controlled in most of our experiments. Nonsense syllables are used in order to control meaning. Our results lead us to stress the importance of feedback to the learner. But much lecturing is devoted to achievement of one of our simplest objectives, communicating knowledge. If the student is motivated, a good deal of communication of knowledge apparently can take place with relatively infrequent checks on the progress of the learner.

By experimental control of learning conditions we miss the important fact that when knowledge is presented by a teacher he is able to respond to feedback from the learners. This may be the most important asset of the instructor. While films and television present material at a relatively fixed rate, an instructor can go faster or slower. When he gets cues of inattention, glares, or blank confusion from his class, he can try a different example; he can ask questions to find out what's wrong; he can make rapid adjustments to the situation.[5]

The reader, too, can pace himself, but the inexperienced reader may not be able to separate the meat of the book from the fat. Even though lecturers are slower than books, a good lecturer may be able to give the student all he needs from a book in much less time than it would take him to read it.

Textbooks, films, and linear programs must be organized to fit the average or poorer than average student if they are to be economically feasible. The lecturer, on the other hand, can not only plan his lecture for his own class, but he can respond to feedback from his students as he delivers it. This responsiveness to cues from the class is probably one reason why material can be covered less rapidly in live classes than in television classes. Yet one might hypothesize that this very responsiveness may make for greater effectiveness than that of a carefully organized, inflexible presentation. In fact, the tightly packed television lesson may allow too little opportunity for consolidation of learning. Pockrass (1960) found that television lessons were more effective when viewed with a rest period.

If we examine the mass of research comparing college level instruction by television with live instruction, we find some support for the idea that live instruction is most effective where flexibility is important. In those cases in which the live instructor was superior, the courses were predominantly those in which instructors traditionally use discussion or lecture techniques involving some student participation--courses in which the content is not highly organized, such as psychology, the social sciences, and humanities (Carpenter and Greenhill, 1955, 1958; Macomber and Siegel, 1956). While there is little relevant research evidence, we would thus expect live lecturing to be most effective in situations where we want to reach students varying in ability, relevant background, or motivation, where the content has no well-defined structure, and where flexible adjustment to the group is thus important.

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[5] But note that this adjustment cannot deal with all of the individuals in the class.

One of the arguments for a live instructor is that he is a model with whom some students will identify. We know very little about what factors influence us to adopt an instructor as a model. One might expect identification to have something to do with the student's emotional relation to the instructor and one would thus expect well-liked instructors to be more effective in producing changes. But most of the studies of students' liking for instructors show that student liking of instructors is even less related to student achievement than are student ratings of other characteristics of the courses. However, the effects of identification should probably occur in the areas of attitude change rather than of achievement. In one small study we found some tendency for students of well-liked instructors to elect more courses in the same field (McKeachie and Solomon, 1958). But there seems to be little other evidence to support the identification-attitude-change hypothesis. If the student's tendency to model himself after the instructor has anything to do with personal interaction with the instructor, it may be an ominous finding that students don't seek personal conferences with television instructors as much as with "live" instructors.

One of the interesting sidelights of research on television, however, is that several researchers report that the attitudes of students toward television are influenced by the attitude of the proctor in their viewing room. If their proctor favors television education, the students also tend to favor it. If he disapproves, so do they. This is a very simple sort of taking over of an attitude, probably too simple to even be labeled identification. But if the proctor, whose chief activity is turning on and off a television set can have such an effect, what effects must an active, prestigeful instructor have?[6]

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[6] For an insightful discussion of this topic, see J. Adelson, The teacher as a model. In N. Sanford. The American College, New York: Wiley and Sons, 1962. Chapter 10.

Summing up the liabilities and assets of the instructor as a lecturer, on the negative side we have:

The lecture is a slower method of presenting information than reading or television.

The student in a lecture often plays a passive role.

On the positive side, however, is:

A live instructor can respond to students. Because he can observe student reactions, the lecture may be more effective than a more highly organized, pre-planned instructional technique.

The lecture may have some motivational value beyond that of other techniques of instruction. Motives for recognition and approval can be elicited and reinforced by the instructor.

The discussion leader

Let us turn to a second common role of the classroom instructor, that of discussion leader. Most discussion leaders admit that they cover less ground than lecturers. But they argue that students can better apply the material if they have discussed it. Real "gut" learning, they say, requires the more permissive atmosphere of the discussion class.

Here, too, the evidence is scanty, but it tends toward support of the hypothesis that discussions can be effective in achieving these aims. Note that I say, "tends," for I suspect that much discussion teaching is relatively ineffective in achieving any objectives of education. (In fact, I might point out that none of the studies of teaching methods have sampled instructors in such a way that we know how the results can be generalized.)

Let us look again at the purported functions of the instructor in discussion leading. If we are trying to achieve application, critical thinking, or some of the higher cognitive outcomes, students should presumably have some opportunity to practice application and critical thinking and to receive feedback on the results. Group discussion (as well as other methods) provides an opportunity to do this. While teaching machines and mock-ups may also be programmed to provide prompt and realistic feedback, group discussion permits presentation of a variety of problems enabling a number of people to gain experience in integrating facts, formulating hypotheses, amassing relevant evidence, and evaluating conclusions. Bloom and his colleagues at Chicago (1953) used recordings of classes to stimulate students to recall their thought during class. They found that discussion did stimulate more active thinking than did lecture classes. (However, it's worth noting that students' minds wandered more in discussion than in lecture.) Several studies suggest that discussion results in more critical thinking than other methods of teaching (Barnard, 1942; Dawson, 1956; Bovard, 1951a; Patton, 1955; Carpenter, 1959).

The "gut" learning argument is also difficult to verify. Essentially the argument is that some desired learning encounters emotional barriers which prevent it from affecting behavior. For example, a student may learn that distributed practice is effective, but not change his study methods because his anxiety about grades is so great that he doesn't dare try anything different. In such circumstances experiments on attitude change suggest that the instructor must either bring about changes in underlying attitudes and motivation or must change the individual's perception of the instrumental relationship between his behavior and his motives.

In addition, most attitudes have some interpersonal antecedents, and are stabilized by one's perception of the attitudes other liked persons appear to have. Group discussion may facilitate a high degree of liking for the instructor as well as other group members. Presumably, the individual thus becomes more likely to adopt their attitudes. Discussion also permits more accurate assessment of group norms than is likely to occur in other techniques of instruction. Consequently, change may follow. In fact, while individual instruction would be advantageous for many teaching purposes, the presence of a group is a real advantage in bringing about changes in motivation or attitudes. As Kurt Lewin showed in his classic experiments on group decision (1952), it is sometimes easier to change a group than an individual.

Bringing this down to the teaching situation, Bovard and I showed that, as predicted, a method of teaching involving use of group decision did produce more conformity to group norms on social attitudes than did a discussion method in which the instructor played a more dominant role. This increased conformity was apparently due not only to greater liking for the group, but also to more accurate perception of the group norms (Bovard, 1951b; McKeachie, 1954). Moreover, we found that our "group" teaching affected ability to apply learning, even though the two types of classes performed equally well on a standard achievement test. Although many experiments report negative results, those of Gibb and Gibb (1952) and Asch (1951) also report that student-centered classes produced results superior to those of traditional classes on measures of behavioral and personality change. Recent research at Penn State has shown that, as compared with conventional classes, remarkable increases in motivation and critical thinking occurred in supplementary discussion groups taught by undergraduate majors (Carpenter, 1959).

As Tyler has suggested (1960), emphasis in education is being placed increasingly upon understanding, motivation for further study, problem solving and broader appreciation of literature and arts. These are the very objectives for which discussion is most likely to be superior to other methods of teaching.

In this connection Thistlethwaite's National Merit studies are damaging to educational theories based on rote-learning research. We have always thought that prompt feedback and well-structured sequences of presentation were conducive to learning. The Thistlethwaite studies indicate that the top colleges in production of scholars are ones where tests are infrequent and where students don't know what to expect next. If there is a cause-effect relationship in this, maybe we need to throw some random elements into our teaching machines. That this is not a preposterous idea is indicated by the success of the "scrambled" book developed by Lawson, Burmeister, and Nelson (1960) and the finding by Roe, Case, and Roe (1962) that a scrambled-program worked as well as an ordered one. In any case, these results suggest that techniques most suitable for rote learning may not be those most effective for developing motivation and high level achievement.

This proposition is also supported by a study we conducted in which we found that those instructors who were the most effective teachers as measured by their students' performance on a multiple-choice objective test tended to be those with frequent tests and clear organization (McKeachie, 1959). However, these instructors tended to be the least effective as measured by their students' performance on an essay question designed to measure critical thinking.

Analysis of the role of the instructor is further complicated by the fact that some students do well with one type of teaching, while others do well with others. Additional complications are undoubtedly introduced by the probability that the best method of instruction may depend upon the instructor or upon the content or goals of instruction. This means that we need a great deal of research on interactions between the many factors entering into the complexity of educational situations. We need to push forward on research dealing with such broad questions as:

What are the effects of new media upon teacher self-perceptions and development?

What are the effects upon student perception of teachers? Upon student relations to teachers?

What are the effects on the teacher's status among his peers?

What are the effects upon college alumni and public relations?

What are the effects upon centralization-standardization of educational planning?

What combinations of teaching techniques are most effective for what educational objectives?

In what sorts of colleges and departments do teaching innovations first occur?

What factors influence the spread of innovations?

The new role of the instructor

Thus far it does not appear that the instructor will be superseded. But the new media can be valuable resources in enabling the teacher to accomplish goals more easily and effectively. Just as the language laboratory can help the student be better prepared to gain maximally from class periods, so learning laboratories for other courses can provide printed materials, recordings, programmed materials, and filmed materials to enable a student to review, or to experience a concept through different senses and in a different context, or to practice skills.

This means that the instructor more than ever will become an educational planner--one who has available a variety of resources to meet the varying objectives of his teaching and the varying needs of his students. Cataloguing and technical developments should be such that he can locate useful aids quickly and use them flexibly without fear of technical breakdowns or failure of communication in the learning resources center. To aid him in his planning he will need to have available detailed knowledge of his students' progress through computerized record-keeping. With this he should be better able to plan both for the class as a group and for individual learners.

It seems likely that in the ideal future college many of the resources for learning will be more conveniently accessible to students than on most present day campuses. Housing units will not only have television sets but also consoles for teaching machines, language recordings, tapes, films and reproductions of printed materials. Tapes or films of televised instruction will be available for individual review. Paperbacks will be retailed in housing units as well as in supermarkets. This does not mean that the library will disappear. Aside from its expanded resources of learning, it will continue to be a convenient locale for study dates. But through television, facsimile transmission, and other devices, the library's resources will be more available throughout the campus and off campus. As the central facility for information storage, the library will be an even more important part of the campus of the future than it is today. Books, rather than disappearing from the educational scene would, I hope, become even more common and widely available. A major advantage of the book as an educational medium is that using books to learn is a habit which more readily transfers to later out-of-college learning than using teaching machines, educational television, or professors.

In the classroom itself the teacher's role as a dispenser of information is likely to be reduced and his role in stimulating thinking and as a model is likely to be enhanced. Discussion techniques are likely to be increasingly evident in the classroom, but the stimulus to discussion may come from a television presentation, a film, a simulation, or printed materials.

But while the college campus itself may not be visibly changed by the new media, the reach of education should be lengthened. When a major figure visits campus, he may still be seen in a major address in a large auditorium, but students in their rooms will also be able to watch interviews with him together with films of his research or scholarly activities used as illustrations. The small college lacking a staff member in a given field may still offer a filmed course with programmed materials, text and resource readings, and telephone discussions with an instructor at the nearest university. Extension courses may make similar use of such materials. Through broadcast television, a state university may literally make its whole state a campus.

The use of television, teaching machines, and independent study will put under great stress our present conventions of granting credit toward graduation in terms of hours in a classroom. More and more we will grant credit on the basis of examinations--examinations designed not only to evaluate acquisition of knowledge, but also designed to measure higher levels of cognitive and, perhaps even, attitudinal change.

With such examinations and with filmed, taped, and programmed courses, the college curriculum of the future will be much more flexible than that of today. With convenient ways by which students can fill in missing background, it should be possible for advanced courses to advance rather than to refurbish elementary materials ill-learned in earlier courses. Students may have greater opportunity than before to gain a knowledge of at least the elementary concepts in a number of fields outside their major fields of specialization.

Finally, we will find in the ideal university of the future a well-staffed and adequately financed center for research in learning and teaching. The new media offer unusual challenges and opportunities for research. Because teaching methods can be highly standardized in films or teaching machines, and because learning stimuli can be presented and responses can be recorded continuously and fully analyzed in computers, there will be a much closer link between laboratory research on learning and educational research. With continuing evaluation and rapid use of feedback by the educational planner (the teacher), educational effectiveness will grow at a positive rate of acceleration.

A Jaundiced Eye Toward the Future

Will this vision of the ideal situation actually come to pass? Perhaps--in some classes, in some colleges, but the entrenched conservatism of faculties, the tradition of antagonism toward "educational" methodology, coupled with the greater expense of new technical resources is likely to make change come by degrees rather than overnight. Some college administrators will no doubt see public relations values in being the most "modern" institution of higher education, and in these institutions the new media may be exploited as substitutes for the interpersonal interaction of students and teachers. But partly because of extensive use of new media by low-prestige colleges, the prestige institutions may be even more resistant to using the newer media, and thus fail to take advantage of their full potential.

Education is complex and educational decisions are often difficult to justify. In institutions dominated by the newer media both professors and administrators can avoid the pain of decision by casting this burden on the producers of automated systems (Johnson and Kobler, 1962). The teaching machine and television set cannot be swayed by emotional biases. It will, therefore, seem obvious that their educational methods will be fair to all. The resulting centralization of decisions may be the just deserts of those who are willing to abandon their responsibility.

Since technical changes can be accomplished more rapidly than changes in values and social organization, we are likely to see a period of increasing tension between faculty, administration and boards of trustees, and between faculty and students. Student values and expectations may well change more rapidly than faculty, since the student society in colleges has a high rate of member turnover. Yet both faculty and students will find old patterns of response blocked and new skills and precepts required. With faculty members devoting a considerable portion of their time and energy to skirmishes on class size, use of mass media, and control over their own classrooms, less time will be left for creative teaching and scholarship, and we will thus have still another factor contributing to a down-grading of the quality of instruction.

We thus are likely to find a clear dichotomy between institutions using new media extensively both as supplements and substitutes for live teaching and those institutions stressing personal instruction. One of the most important differences in these institutions is likely to be in the role and status of instructors. With a large investment in technical aids to education, college administrators and boards of trustees are likely to exert an increasing degree of control over teaching in order to insure maximal return on the investment. Since many of the institutions making maximal use of the newer media will be those unable to attract the best teachers, this may not be an educational loss. Nevertheless we are likely to see a downward spiral in staff caliber in such institutions. As investment in automation reduces instructor autonomy and sense of worth, good professors leave and it becomes more difficult to recruit new ones; the need for machines then becomes greater, and administrative confidence in the faculty becomes less, resulting in diminished teacher autonomy and a continuation of the spiral.

Adding to the changing role of the faculty member in the automated university will be the complexities of scheduling problems introduced by the use of the newer media. If expensive teaching machines, films, and television are to be used efficiently, a great deal of attention must be given to maintenance, scheduling, and the use of space. Computers can reduce the difficulty of solving these problems, but the professor's power to change his mind, make exceptions, or put off planning his class until the last minute is likely to be reduced. While it is probably desirable that professors be encouraged to plan ahead, most of us have had the experience of brilliant success with the virtually impromptu development of a class session based upon some topical theme. Since many of the new media require advance preparation (or at least advance arrangements), such flexibility is likely to be reduced, and the ordinary classroom teacher may lose one of the possible sources of fun in teaching.

Many of the consequences of centralization and standardization will be good, but with credit awarded by examination, we may have at the college level some of the same abuses that crept into the standardized test movement in public schools before World War II. Both students and teachers may believe that the student has been educated when he has been adequately coached on memorizing the answers to the specific sample of bits of information included on the tests. Conventional education has probably done little enough in helping students develop new ways of thinking and new vistas of the major fields of scholarship. It would be tragic if this little were sacrificed at the altar of achievement tests constructed to weigh most heavily those outcomes most easily measured, albeit least important.

The problem of adequate measures of educational outcomes brings into focus the major issue of the values which dominate education. If the newer media come to carry the major burden of instruction, the multiplicity of values, the uniqueness of academically free professors, and the variability of colleges will be reduced. Much of this variability could well be sacrificed, for some is variability resulting from ignorance, prejudice, and rigidity. But some of the lost variance may represent color, spice, and creativity which higher education can ill afford to lose.

The image of the "Master Teacher" producing a lesson for millions of students is one that is already very appealing to the layman, and we may thus find considerable reward for those professors who enjoy the role of actor-producer in the era of the new media. Nevertheless, it seems unlikely that the professor who works with students (rather than with technicians) will disappear from the academic scene. Every campus has always had brilliant lecturers and outstanding showmen. But important as they have been, most administrators, alumni, and students have recognized that the professor leading discussion in a seminar or discussing a paper with a student in his office was the real center of educational process. He will continue to be.

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CHAPTER IX

THE IMPACT OF THE NEWER MEDIA ON ADULT EDUCATION

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In examining the impact of the newer media on adult education it will be helpful to distinguish between the education of adults and adult education. As defined by C. Hartley Grattan:

> All those influences which have an impact on the adult mind, and which "condition" it, may on this distinction be called the education of adults, while those activities which are educational by intent may be called adult education.
>
> Grattan, 1955, p. 9

The Newer Media and the Education of Adults

That adults continue to develop in knowledge, values, interests, skills, and attitudes after they complete their formal schooling is attested to by observers of all cultures. In the past the means available for continuing education during the adult years have consisted primarily of the informal learning-from-experience that is inherent in being alive and the learning-from-books-and-people that describes more systematic self-education. While these traditional means have no doubt made differences in total cultures, their greatest impact has been on particular individuals--the individuals characterized by Houle in his *The Inquiring Mind* as "the continuing learners":

> ....the continuing learner has existed in every age. To anyone with a classical education, examples from antiquity come readily to mind. Plato's dialogues and the contemporary descriptions of the Lyceum and other schools testify to the passion for lifelong learning among at least a few of the Greeks. The works of Plutarch, Cicero, and other Roman writers

> are rich with illustrations; among them are Cato learning Greek at eighty, Alexander carrying the works of Homer with him everywhere, and Caesar trying to plan each day so that it would include administration, sleep, writing, and study.
>
> (Houle, 1961, p. 10)

With the coming of what Bryson has labeled "the third communications revolution," however, the continuing education of adults has tended to be accomplished more through the effect of the newer media on the total culture than through their effect on the selective development of particular individuals. Bryson explains that the first communication revolution, the invention of writing:

> ....need not hold us because the ideographs engraved on stone or baked into clay tablets, or even written on papyrus, were the manuscripts of the few, not the books of the many, and the deep changes they made took a long time to show their social meanings.

while the second revolution, the invention of printing, "made what we now call adult education possible and lifted upward the whole practical as well as the intellectual life of Europe." Bryson calls the third communications revolution, the invention of electrical transmissions of all kinds, the most striking event of the twentieth century because it has moved us into an epoch "when persons of the same generation in two different places may be much more alike than are two succeeding generations in one place" and because it has released forces that "have almost destroyed the peasant mind and established a new man who can be characterized by his interest in ideas instead of an interest merely in things." (Bryson, 1954, pp. 59-90.)

What, specifically, have been the effects of these newer media on the education of adults?

Research techniques have not yet been devised that can give definitive answers to this central question, principally because of the impossibility of controlling such other variables influencing our culture--rapid transportation, rising levels of education, the explosive expansion of organized adult education, and the multiple effects of urbanization.

A growing body of empirical research into the effects of specific influence attempts indicates that the mass media can produce changes, especially in the areas of knowledge, attitudes, and values, but that these changes tend to be temporary unless reinforced; and that the strength of impact is greatly affected by such factors as the status and credibility of the communicator, the qualities of the communication, the predisposition of the audience, and the degree of participation by the audience. (Hovland, 1953, pp. 269-281.) Berelson confirms the complexity of the problem when he indicates that the only answer available from research to the question, "Do communications influence public opinion?" is this:

> Some kinds of communication on some kinds of issues, brought to the attention of some kinds of people under some kinds of conditions, have some kinds of effects.
> (Schramm, 1954, p. 345.)

Studies of the relative effectiveness of various influence attempts have resulted in the formulation of such principles for increasing the impact of a program as the following:

1. The more a program reinforces the needs and attitudes of people, the more successful it will be;

2. The more the content of a program reinforces what an individual has experienced, the more successful it will be;

3. The more the content of a program reinforces needs an individual expects to face in his near future, the more successful it will be;

4. The more the content of a program takes advantage of reinforcement from other media and the immediate social situation, the more successful it will be;

5. The more the content of a program reinforces needs which relate to specific role, or things we do, the more successful it will be among those who take those roles;

6. The more frequently and the more recently the content of a program reinforces needs, the more successful it will be;

7. The more a program reinforces needs so individuals will resort to the theater, to books, or to other sources for further reinforcement, the more successful it will be,

8. The more immediate or pleasure-giving the rewards offered to individuals by the content of a program, the more successful will it be;

9. The more emphasis upon, and use of, delayed-reward subject matter in a program, the greater the intellectual ability required of the audience;

10. The more the key ideas, the major themes, the essential information in a program are translated into photograph, the more successful will the program be;

11. The more information and the greater the complexity of ideas in a program, the more intellectual ability will be required for learning;

12. The more the personalities in a program appeal to individuals, the more successful it will be;

13. The easier the physical availability of programs to individuals, the more successful they will be;

14. The more advance notice the persons in a potential audience have of a program, the more likely they are to attend to it. (Adapted from Charles E. Swanson, "Guides to Success in Educational TV," in Hudson, 1953, pp. 127-131.)

Presumably, through the refinement of such research-based principles as these it will be possible to increase the effectiveness of particular influence attempts in the newer media in the future. Meantime, what have been the overall effects on the general culture to date? The answer to this question is even more controversial than the answer to the question about specific effects.

Some social analysts can see nothing but cultural decay ensuing from the rise of the mass media. Dwight Macdonald (1953), for example, predicts that public taste will decline because of the "spreading ooze of Mass Culture." Rosenberg (1957) bemoans the oversimplification of social problems in the mass media and expresses fear that they blind citizens to the complexities that must be understood if they are to act intelligently. Packard (1957) and Mayer (1958) point to the danger of manipulation by those who control the mass media. Riesman (1953) and Whyte (1956) decry the pressures toward conformity exerted by the mass media. Many others could be cited to support the school of thought holding that the net effect of the mass media is to reduce culture to the least common denominator of interest in trivia, violence, sensationalism, quackery, emotionalism, lust, and materialism.

Others believe that the net effect of mass communication has been culturally uplifting. David M. White, for example, points to the rise in the sale of great works of literature in the form of paperback books, and the increase in sale of classical records--concluding that mass communication has not destroyed public taste, but has provided the raw materials for bettering it (White, in Rosenberg and White, 1957). Bryson chides the critics for always being prophets of doom and being custodians of standards of the past, and goes on to assert that "it is useful to admit the possibility that a second-rate art object may be either the cause or the effect of a first-rate experience." "This is hard doctrine for esthetes," he continues, "but educators cannot escape it. I think we have to go so far as to say the new vehicles of communication in our time--cinema, phonograph, radio, television--have done more to advance our culture by second-rate drama and light music than would have been accomplished by graver and more demanding programs." (Bryson, 1954, pp. 71-72.)

Certainly mass communications, along with other influences, have contributed to changes in the American culture that have important consequences for the continuing education of adults. For example, extreme regional differences in language, consumer taste, and cultural interests have begun to be reduced. The sharp distinctions in way of life between rural and urban populations have diminished. Many of the more visible marks of differentiation between social classes, such as dress, leisure-time activity, and standards of conduct, have tended to become blurred. These tendencies, together with the fact that by 1960 television sets were located in 88 per cent of the households of the country, begin to point toward an environment for continuing learning never visualized by even the most extreme utopians.

The Educational Policies Commission, in its 1958 appraisal of "Mass Communication and Education," was especially concerned with assessing the impact of the newer media on the citizen as a learner. It found that the impact was great, but that the effects were mixed. "The contemporary citizen of the United States, because of this country's development of mass communication," the Commission reported, "has the raw material of knowledge in his hands to an extent unknown when the twentieth century turned the corner." In support of this assertion it pointed out that the average American of 1900 had never seen a national political convention, an opera, a Presidential inauguration, or a joint session of Congress, whereas these things are routine for youth and adults alike today. "It is important to observe, however," the Commission cautioned, "that the new knowledge, vicariously and easily arrived at, is not necessarily profound, meaningful, or even accurate. A sense of reality and participation is no guarantee of arrival at understanding." It proceeded to point out that the selectivity exercised by the media affects the new view of the world and that much information is imperfectly absorbed.

The Commission was also disturbed that the continuing learner's secondary experience is greatly enlarged at the cost of primary experience, with the result that we are tending to become a nation of spectators rather than active participators. "The spectator's or listener's learning from the mass media is more superficial and less predictable than that which is mentally rehearsed with retention in mind; it tends to be impressionistic rather than analytical."

Unquestionably the newer media of mass communications have had a tremendous influence on the continuing learning of adults, although their specific effects are difficult to prove or measure by research. No doubt some of these effects have been positive and some have been negative, as evaluated by adult educators and social philosophers. But the net effect seems to be in the direction of producing an environment more conducive to continuing learning.

The Newer Media and Adult Education

Although the education of adults has been going on since the beginning of human history, adult education as an institutional field of operations is a modern phenomenon. The first national recognition of the existence of such a field was in 1926, with the formation of the American Association of Adult Education (which was succeeded in 1951 by the Adult Education Association of the U.S.A.). In order to be able to assess the impact of the newer media on this field, it may be well to take a few pages to describe what it is.

What Is Adult Education?

In its simplest definition, adult education consists of a wide variety of activities organized specifically for learning by adults under the auspices of myriad organizations. It is such a new and dynamic field that it has not yet taken stable shape, but its main outlines can be described.

The fact is that there is no single, comprehensive social philosophy that cements the various elements of the field into a cohesive whole. Each individual adult enters into the field with his own unique needs, motives, and objectives, and seeks to satisfy them by almost random sampling of the a la carte menu laid before him by the diverse agencies of adult education. Seldom does an individual have a coherent plan for achieving certain objectives of continuing growth by specified sequences of learnings; there are few institutions in the field that can supply him with a ready-made plan into which to fit.

The field of adult education is essentially organized on a philosophical platform of need-meeting rather than one of goal-seeking. Some adult educational programs are primarily concerned with meeting whatever needs individual adults are aware of at the moment, and these may range from learning to dance to learning computer mathematics. Other programs are designed primarily to meet the needs of the sponsoring institution, such as the need of a business firm for more competent supervisors or the need of a labor union for more loyal members. Still other programs are directed mainly at meeting needs of local communities (such as the need for a better informed citizenry regarding problems of urban renewal), or the nation (such as the need for skilled civil defense volunteers), or society in general (such as the need for the elimination of illiteracy). Some valiant attempts have been made, especially by the Fund for Adult Education of The Ford Foundation from 1951 to 1961, and by a few universities, to develop a comprehensive plan for a lifelong sequence of liberal education. But all such attempts so far have been highly intellectually oriented and have failed to take into account the full range of developmental needs during the adult years, with the result that their appeal has been limited largely to an intellectual elite. The field is still awaiting the emergence of viable concepts of core curriculums and comprehensive plans for lifelong learning.

The institutional dimension of the adult educational field is more crystallized than the philosophical, but it is so complex as to defy clear description; it lacks the simple symbolism of the institutional structure of youth education--the elementary school, high school, and college campus. In fact, adult education takes place principally in institutions that were established primarily to serve other purposes, so that there are few purely adult educational institutions. The institutional dimension of adult education is therefore all tangled up with the institutional dimensions of other fields, such as social work, commerce, government, and youth education. But, as adult education has become increasingly specialized in its theory and methodology, it has become increasingly possible to distinguish the adult educational component in the wide variety of host institutions. The sum of these components constitutes the institutional dimension of the adult educational field.

Participants

Perhaps the most striking fact in the National Opinion Research Center's report about the participants in organized adult education in this country is their sheer number. Johnstone's NORC report (1963), the most comprehensive statistical analysis ever made, estimates, on the basis of the projection of its sample to the total population of one hundred and fourteen million adults, that "close to twenty-five million adult Americans (better than one in five) were active within some educational category between June, 1961 and June, 1962" (Johnstone, 1963, p. 25). Enrollments by categories were as follows (note that some individuals were enrolled in activities in more than one category):

Enrolled in adult education courses	17,160,000
Engaged in independent self-education	8,960,000
Enrolled as full-time students	2,650,000

The survey inquired into the social and personal characteristics of the participants and emerged with this profile of the "typical" adult education participant:

> He is just as often a she; is typically under forty; has completed high school or better; enjoys an above-average income; works full-time and most often in a "white collar" occupation; is typically white and Protestant; is married and is a parent; lives in an urbanized area, and more likely in suburbs than inside a large city; and is found in all parts of the country, but more frequently on the West Coast than would be expected by chance. (_Ibid_., p. 81.)

Statistics regarding two of these characteristics are worthy of special note: those having to do with age and education. The median age of adult education participants was 36.5 years, compared with a median age of 42.8 years for the total sample; and, interestingly, the distribution of the participants between the twenty to twenty-nine and thirty to thirty-nine age groups was exactly equal: 28 per cent in each. This skewing toward the younger age groups can be explained at least in part by the statistics on level of education. The median years of schooling for participants was 12.2 years, compared with 11.5 years for the total sampling (and therefore, a substantially lower median for non-participants). This finding supports a doctrine that has long pervaded the adult education field: that the better educated a person is, the more likely he is to continue learning. Since the younger age groups are better educated than the older age groups in the present population, it is reasonable to expect that as they become older a rising proportion of older age groups will be found in future surveys of participation in adult education.

Types of subject matter studied

The NORC report found that the major emphasis of adult education "is on the practical rather than the academic; on the applied rather than the theoretical; and on skills rather than knowledge or values" (p. 47). It estimated the distribution of enrollment among various categories of subject matter as follows:

Job-related subjects and skills	9,020,000
Hobbies and recreation	5,470,000
Religion, morals and ethics	3,820,000
General education subjects	3,500,000
Home and family life subjects	3,440,000
Personal development subjects	1,700,000
Current events, public affairs and citizenship .	1,080,000
Agriculture	320,000
Miscellaneous (driver training, military science)	970,000

The report gives the following succinct interpretation of these figures:

> Subject matter directly useful to one's performance in the areas of work, family, and social-personal adjustment, represent a significant proportion of the total activities. Taken together, the vocational, agricultural, home and family life, and personal development categories total to an even 50 per cent of all subjects studied. On the other hand, the academic, religious, and public affairs categories, which are much more representative of the realm of ideas and values, make up just 27 per cent of the total courses. These results point strongly to the pragmatic quality of adult education in America. (Ibid., p. 47.)

This statement supports the assumption that underlies the practices of most adult educators: that adults typically enter into further education to seek help in dealing with life problems rather than to master a body of subject matter for its own sake. Adults tend to be problem-centered in their approach to learning, whereas youths are accustomed to being subject-centered.

Methods and techniques of adult education

The most frequent method or format of adult learning found in the NORC survey was the organized class (56.2 per cent), with other methods following in this descending order: group discussions (10.8 per cent), lectures or talks (10.5 per cent), correspondence study (8.4 per cent), private teachers (7.8 per cent), on-the-job training (7.7 per cent), and educational television (1.5 per cent). Significantly, only 17 per cent of all enrollments were for credit (pp. 48 and 68). These formats do not include, of course, the almost nine million participants who engage in independent study, and for some reason they do not take into account the thousands of Americans known to take part in educational conferences, workshops, institutes, residential laboratories, and community development programs with an educational focus.

But even this degree of shift toward the informal end of the format spectrum does not convey fully the difference between most modern adult educational activities and the traditional instructional class. Even in the most highly structured class adults are increasingly exposed to a body of techniques uniquely tailored to the problem-centeredness and experience background of adult students--case method, critical incident process, role-playing, team learning projects, audience participation devices, and various kinds of group discussion (book-based, socratic, permissive, unstructured, guided, group-centered, leader-centered, brainstorming, problem-solving, instrumented, etc.). The technology of adult education is tending to be more and more based on learning-from-experiences and less and less on transmittal of knowledge.

The Impact of the Newer Media on Adult Education to Date

Obviously, in a field as variegated and unorganized (if not disorganized) as the above description reveals the adult education field to be, impacts of any kind are likely to be spotty and sporadic. Changes occur more by osmosis than by planned strategy; by voluntary adoption rather than by edict or pressure. And this has certainly been the case in regard to the impact of the newer media.

As aids to learning

The media that have made the greatest impact are no doubt those that fit under the classification "audio-visual aids"--motion pictures, filmstrips, exhibits, models, flip charts, slides, diagrams, charts, and the like. These were visible in most of the activities we observed during our research.

Although by far the greater proportion of audio-visual materials in existence are directed primarily to youthful audiences, a growing volume is being prepared for adult audiences. Large amounts of free or low-cost materials are available from government agencies and private industries, especially in subjects having to do with industrial training, agriculture, travel, conservation, health, and public affairs. Most religious denominations, international labor unions, and other national voluntary organizations have collections of audio-visual materials for use by adult groups; indeed, in the directory of national organizations in the Handbook of Adult Education (Knowles, 1960), the most frequently mentioned services are the supplying of pamphlets, booklets, films, exhibits, filmstrips, recordings, flip charts, and the like. The volume of materials is now so large that a variety of guides are published to help the leaders of adult groups find their way through the jungle (Dale, 1954, pp. 88-92; and the "Resources--AV" section of the monthly issues of Adult Leadership). Materials from a variety of sources are available from the collections of numerous commercial film bureaus, university audio-visual centers, and public libraries.

The nature of the impact of audio-visual materials is difficult to assess, but it is probably greater in the case of adult education than in youth education. The reason for this speculative generalization is that on the whole teachers of adults cannot rely as heavily on textbook reading and other homework as can teachers of children, and so they are forced to find ways to bring condensed information into the classroom. The difference would no doubt be even greater, however, if more adult-oriented materials were available, and if they were more creatively packaged into integrated learning experiences. Prototypes of such integrated learning experiences were provided by the experimental discussion programs developed by the

Fund for Adult Education between 1951 and 1961 on such subjects as "Ways of Mankind," "Looking at Modern Painting," "Parenthood in a Free Nation," and "Democracy in America." These "package programs" included collections of readings, recordings, reproductions of paintings, and leaders' guides.

As primary instruments of learning

Where the newer media have been used as the primary or exclusive instruments of learning, as in the case of "telecourses," or courses by film, their impact has been disappointing. For example, the NORC study found that only fifty-nine adults out of 23,950 in its sample (some .002 per cent) had followed an educational course on television. The report concluded that:

> The results of this survey would indicate that television as a form of adult instruction does not as yet represent a very significant force. . . .It is surprising that a medium capable of attracting the largest audiences ever known should attract so few followers in its educational efforts. (Johnstone, 1963, p. 50.)

In seeking an explanation, the report goes on to speculate that:

> Open-circuit instructional television is still very much in its growth phase, but there is reason to believe that factors other than sheer availability may be behind this. If it is true, as some observers have noted, that television has come to be almost exclusively identified by the American public as a medium of light entertainment, it may be that no matter how much instructional fare were made available on television, other channels would still be preferred for formal learning experiences. (P. 135.)

But beyond the American public's stereotype of television as an instrument for light entertainment, there may be an even more fundamental reason for television's relative failure as a primary instrument of learning. Continental Classroom was produced with all the skill and finesse of fine entertainment and it was shown at a time that did not conflict with already popular programs. Yet thousands of more poorly conducted adult education classes in community schools throughout the nation, meeting in prime evening time, picked up much larger audiences than Continental Classroom. Why?

Perhaps it is precisely because educational television has looked to the entertainment industry for its rationale, guiding principles, and techniques, rather than to adult education. Entertainment has as its goal satisfaction and pleasure in the present moment; adult education's goal is dissatisfaction and change. Entertainment puts its participants in a comfortable, relatively passive role; adult education puts its participants into the highly active role of engaging in a process of self-inquiry. Entertainment treats its clientele as a more or less uniform audience with common needs, interests, tastes, and purposes; adult education sees its clientele as a collection of individuals, each with his unique needs, interests, tastes, and purposes, and assumes that these individual differences will cause differences in what is learned. Entertainment establishes a relationship of one-way flow of communication from transmitter to receiver; adult education relies heavily on dynamic interaction among the learners and between learners and teachers. Entertainment assumes that the transmitters are in the best position to know what is good for the receivers; adult education assumes that learners will in the last analysis learn best what they choose to learn. (Gibb, "Learning Theory in Adult Education," in Knowles, 1960, pp. 58-61; and Miller, 1964, pp. 265-288.)

Since mass media, by themselves, cannot involve the learner and his experience actively in the learning process and do not allow him to interact with teachers and other learners in the process, the presumption is strong that mass media cannot serve as effective primary instruments of adult learning. Perhaps they can truly serve educational purposes only in combination with other media.

In combination with other media

By far the most creative use of the newer media has been in combination with other media in integrated educational programs in which each medium reinforces the others; the success of these ventures suggests that it is in this way that the newer media will make their greatest impact.

One of the pioneering ventures of this type was the Community Education Project operated by the San Bernardino Valley College, California, with financial support from the Fund for Adult Education. This program is described in the 1955-1957 Report of the Fund as follows:

> In 1953 the Community Education Project began to develop programs around two of the series of records produced by the National Association of Educational Broadcasters--first Ways of Mankind, then Jeffersonian Heritage. A newspaper printed specially prepared supplementary readings on the theme. A commercial radio station broadcast the recordings. One thousand people in ninety-seven groups met to listen and then discuss issues raised by the articles and the broadcasts. Most of the groups met in homes.
>
> After using these radio programs, the Community Education Project began the creation of its own dramatic radio-discussion programs. . . .These radio programs have included not only scripts and original music but also supplementary reading materials, bibliographies, participants' manuals, and special manuals for discussion leaders. . . .
>
> A system of leadership training has evolved. . . .As the San Bernardino Valley is transformed into a "classroom," thousands of people learn the facts about issues and problems, and, in turn, discuss these matters in an extended "town meeting."

Experiments of a similar character were conducted in Sioux City, Iowa, Salt Lake City, Yellow Springs, Ohio, and other communities. When Eugene Johnson, the architect of the San Bernardino project, moved to Washington University in St. Louis in the mid-1950's he added another dimension to the demonstration of the power of mass media in combination with group discussion. He instituted the St. Louis Metroplex Assembly, which operated twice a year, each time for a period of six to ten weeks. Each evening program consisted of three units: (1) a half-hour presentation of the issue of the series (such as juvenile delinquency, urban redevelopment, water conservation) on television; (2) a one-hour discussion by more than two hundred listening groups, the findings and questions of which were telephoned in to the station; and (3) a concluding half-hour television discussion in response to the reports of the listening groups. The groups were also serviced with discussion guides provided by the Civic Education Center of Washington University, reading lists of books available from the public library, and newspaper articles appearing before the television program each week.

This pattern of combined mass media programs and group discussion was taken to the national level in the Great Decisions Program, sponsored by the Foreign Policy Association starting in 1955, in which columns and editorials in the newspapers and radio and television programs were supplemented by pamphlets, bibliographies, and study guides provided by the Association for use by self-organized adult discussion groups in the study and discussion of major current issues of foreign policy. A similar format was employed by the National Educational Television network in a ten-week series on The Dynamics of Leadership inaugurated in Boston in 1961.

The combination of television viewing, correspondence study, and periodic on-campus class meetings, has been used in connection with credit courses at Wright Junior College in Chicago, the Bachelor of Liberal Studies degree program for adults at the University of Oklahoma, and the University of Wisconsin Extension Division. The Center for the Study of Democratic Institutions has produced a number of "Tapes for Broadcast and Discussion," with supporting materials, on such subjects as the economic order, the political process, science and technology, and war and peace, which are used in classes and informal study groups. The University of Omaha demonstrated a "National Tele-Lecture Conference" in December, 1962, in which experts from around the country were brought into interaction with the conference participants in Omaha through the device of a "glorified conference telephone call." The following semester two professors at Omaha University and Colorado University exchanged courses by Tele-Lecture.

Several universities have experimented with ways of using closed-circuit television to bring resource people and students into closer interaction than is possible in large assemblies. For example, this writer participated in a conference at Michigan State University in 1961 in which his opening address was seen on television screens by several hundred conference participants in groups of twenty-five scattered around the Kellogg Center for Continuing Education. The groups then discussed the issues presented and designated spokesmen to go to the broadcasting studio to report their findings and engage in a panel discussion with the resource person, with the groups watching the full proceedings by closed-circuit television.

Another kind of new medium that has just begun to be experimented with in adult learning is found in the wide range of electronic data-processing, information-storage, and feedback devices that have been invented in recent years. The simplest examples of the use of this new medium are the individualized programmed instruction devices, "teaching machines," described in another chapter of this volume. The potential to which these devices can be carried when tied in with a computer is illustrated by an experimental program being developed at the University of Illinois' Coordinated Science Laboratory. In this experiment there is a double input into the computer: the programmed lesson material and physiological data about each student (electrocardiogram, electroencephalogram, galvanic skin response, and respiratory rate data). The strategy is to analyze the physiological data and attempt to determine exactly when the student has discovered insights into the lesson material as well as to determine his level of activation. It is planned to place student stations in homes and dormitories, so that students can dial in over telephone lines to the central computer facility for completely individualized home instruction. (Yasaki, 1963, p. 27.)

An example of the use of the computer for immediate group feedback is provided by the instrumented human relations training laboratories developed by Robert Blake at the University of Texas. In these "instrumented labs" data about the feelings, perceptions, and ideas of the group participants are collected by simple questionnaires that are quietly passed around at intervals during a meeting. These data are quickly tabulated and summarized and the results are fed back to the group for analysis and appropriate modification of behavior.

A more elaborate example of the use of this new medium for learning is the "management game," in which the computer is used both for information storage and retrieval and for feedback. In management games a model of a simulated business situation is constructed and then all the data required to deal with a series of management decisions about the business are programmed into a computer. Groups of executives-in-training then compete with each other to come up with the best solutions to given problems. They can retrieve data from the computer in response to specific questions and, at the end, the computer can show the consequences of the decisions made by the various teams, so that the best decision can be determined. The major learning occurs when the teams analyze their experience and diagnose the flaws in the decision-making processes they used. (Dill, 1961.) Several standardized management games have been developed by such institutions as Carnegie Institute of Technology, the American Management Association, the University of Chicago, the International Business Machines Corporation, and the McKinsey Company, that are used by various other institutions and companies. Some companies, such as Proctor and Gamble, have developed their own game for use in training executives uniquely for their company.

Summary

It seems clear that the newer media have made only a relatively paltry impact on the field of adult education to date. But at the moving edges of the field are some creative indications in new directions.

The Future of the Newer Media in the Education of Adults

No doubt new media for learning not even conceived of now will be invented in coming decades. Already experiments are proceeding with subliminal, chemical, electrical, hypnotic, and other forms of stimuli to learning that may revolutionize our notions about how to help people achieve their full capacities. But given our present media and our present knowledge about how adults learn, much more can be done than is now being done to develop the potential of our human resources.

Some Guiding Principles

Contemporary knowledge about adult learning processes, incomplete though it is, suggests some guiding principles for increasing the educative potential of the newer media:

1. Learning tends to be valued by an individual to the extent that a high valuation is placed on learning by those elements of his culture that are important to him. This principle, as we shall see, has special implications for programmatic themes and models presented by the mass media.

2. An individual tends to be motivated to learn to the extent that he perceives the need to learn and the rewards of learning. This principle suggests the possibility of greater innovation in the use of the newer media for exposure to the needs and rewards of learning, and perhaps for new approaches to the self-diagnosis of learning needs and the self-evaluation of learning progress.

3. An adult tends to resist learning to the extent that his self-concept as a self-respecting, self-directing organism is threatened or violated. This principle points to the importance of involving learners in the process of planning their own learning experiences and in making decisions about the use of the newer media.

4. An adult tends to enter into a learning activity with a problem-centered orientation--with the intention of immediate application of his learning to the solution of life problems. Applying this principle, adult learning experiences should be organized around problem situations defined by the learners themselves and material presented through the newer media should be organized according to a problem-solving sequence in preference to a logical subject-development sequence.

5. An adult tends to internalize new learnings to the extent that he is able to incorporate them into his experience. This principle suggests the need to design learning experiences that make use of the learner's experience (as in discussion) and that permit the learner to practice the use of the learning (as in simulation exercises). In a broader sense, it points to the importance of using the newer media in situations that permit interaction among learners and between learners and teachers.

Longer lists of guiding principles have been developed for the education of children and youth, but these seem to the writer to be the central principles underlying modern learning theory in regard to the education of adults. What would happen if they were applied on a broad scale in the use of the newer media?

Some Radical Possibilities

In order to provoke fresh thinking, the following possibilities for increasing the impact of the newer media on adult education are presented, some gleaned from the literature and some from the writer's own analysis.

First, and most fundamentally, the schools and colleges could teach children and youth to be truly self-directing inquirers rather than largely dependent receivers of what teachers think they ought to know. The purpose of education could be re-defined as being primarily to help youth learn how to learn (from their own experience, from one another, from the mass media, and from all other resources, as well as from teachers) and as being only secondarily to help them master prescribed bodies of subject matter. Schools and colleges could perceive their mission as not to educate, but to initiate a process of lifelong self-education. Such a radical change in the traditional objectives of schooling would require a drastic reorganization of the curriculum and of teaching procedures away from information-transmission toward mastery of the tools of learning (including such tools as rapid reading, the ability to formulate researchable questions, the ability to collect and analyze critically data relevant to the questions asked, an understanding of the basic concepts and methods of inquiry of the various intellectual disciplines, a knowledge of the important sources of knowledge, and the ability to state data-based conclusions and to communicate them clearly). But only when the purposes and programs of education for youth are reorganized in this direction will a generation of adults emerge who have the capacity to make full use of the newer media for continuing self-education. Indeed, the full potential of adult education can never be achieved until the institutions of youth education turn out adults who have mastered the tools of learning and enter their maturity with an insatiable curiosity and a deep determination to learn what they now know they need to know.

In the second place, all the mass media could contribute more substantially right now to the establishment of a cultural climate more conducive to lifelong learning. The benefits of continuing education in the adult years could be dramatized without moralizing. Recognition and hero-status could be given to those with inquiring minds, as well as to those with fast guns, sex appeal, folk wisdom, and good voices. Information regarding local resources for continuing education could be disseminated more widely and more appealingly. In many other ways the imaginative mass media could express a high valuation of the concept of lifelong learning.

Thirdly, the processes of public affairs themselves could be more effectively exploited as educative opportunities. More attention could be given to normal, and less to sensational, episodes in the legislative, judicial, and administrative processes of government--especially at the local level. Citizens could be involved more directly in the processes of public decision-making through two-way television. By an extension of the procedures of the St. Louis Metroplex Assembly, for example, organized groups of citizens (perhaps on the basis of scientific sampling rather than of representation of pressure groups) could be brought into direct interaction with city councils and mayors, state legislators and governors, and the national Congress and President. The rest of us could look on as participant-observers, with competent political analysts guiding us toward greater understanding of the issues and processes we are observing. Perhaps something even approaching massive town meetings could be invented, with groups meeting in neighborhoods tied into a network of interaction with the city council. There is no technical reason why this powerful new instrument of communication should be used only by George Orwell's Big Brother to watch over the little brothers; it can be used in reverse just as easily, and for better ends.

action with city councils and mayors, state legislators and governors, and

A fourth possibility would be for the educational television stations (and, conceivably, eventually the commercial stations) to build their programs around the concept of serving organized viewing groups. For example, groups of housewives could be organized to view programs on homemaking problems, groups of leaders to view leadership-training programs, groups of public-spirited citizens to view public affairs programs, groups of music lovers to view music appreciation programs, and so on. Devices could be invented for getting interaction between the viewing groups and the central broadcasting resource. This change of concept would, of course, require the employment of field staffs to maintain liaison with the groups, supply them with materials, and train their leaders. But presumably much of this field work could be done by established organizations--and think of what it would do to revitalize their programs! Such a development would not only surely increase the educational effectiveness of television, but would reap rich rewards in terms of community involvement--perhaps, indeed, even in giving a new meaning to "community."

Fifth, the commercial mass media might use their existing market-analysis procedures to get data about the life problems on which their audience wants help. In this way they might be able to gear their programs to be more helpful in satisfying needs for growth as well as in satisfying needs for products.

Sixth, new devices could be invented for helping adults to become aware of their specific needs for continuing education. Adaptations of

needs for continuing education. Adaptations of

teaching machine programs, management games, instrumented group discussion, loop films with missing dialogue, and other existing devices might also be used for helping individuals diagnose their present personal deficiencies. Similar devices might be developed for helping individuals to measure their progress toward achieving their full developmental potential. These two areas--diagnosis of needs and measurement of growth--are probably the most underdeveloped areas of adult educational technology. When better ways for helping adults to become aware of their needs for learning are available, the problem of motivating them to engage in systematic learning activities will be largely solved.

Seventh, more systematic training could be given to adult educators on the creative use of the newer media--and to the operators of the mass media on principles and techniques of adult education. Eventually even a closer partnership between these two groups in the planning and execution of comprehensive community programs of continuing education for adults might be brought about.

This is just the beginning of a list of possibilities to which every reader can add. When enough people become concerned with the more effective use of the newer media for the education of adults, and their ferment produces enough workable new approaches, then perhaps the newer media will indeed make an impact on adult education that will enable it to fulfill its potential as an instrument of individual and societal growth.

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PART V

GENERAL IMPLICATIONS FOR AMERICAN SOCIETY

Chapter

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CHAPTER X

THE IMPACT OF THE NEW MEDIA ON THE STYLE OF AMERICAN EDUCATION

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In recent years something approaching a technological revolution has seemed to be under way in American education. Between 1960 and 1962 the number of students in schools and colleges taking courses given on television for credit rose from about three hundred thousand to over 2.4 million; the number of such credit courses rose from about one thousand to nearly thirty thousand. (New York Times, September 30, 1962) Interest in programmed instruction, both in conjunction with machines and in the form of programmed textbooks, has grown as dramatically as has educational television. Perhaps as important as these technological innovations, in the long run, will be the effects of the new organizational forms of instruction that go under the name of team teaching.

It is, of course, important to examine these new methods of instruction, to study their effects under various conditions, and assess the evidence that bears on their educational value. But it may also be helpful to look at these new processes in a different way--not so much in terms of their intrinsic properties and effects, but rather as a set of responses to new forces and pressures at work in American education. How can we account for the widespread interest in the educational innovations, the "social resonance" to them, just now? The central idea of teaching machines appeared in the work of S. L. Pressey nearly forty years ago; commercial television has been with us for fifteen years; and there was nothing to prevent the introduction of "team teaching" at any time in the history of American education. The question of "why now?" directs us to a consideration of recent developments in American society and its educational system; it tells us something of the problems to which the new modes of instruction are a response; and it may give us some clues to the kinds of uses to which these new methods will be put in the schools.

The response, both among educators and laymen, to the new technologies and methods of instruction, can be understood best as a product of three conditions which have emerged in American education since World War II:

1. The first of these is the greatly increased concern, in the society at large, but also among educators, with "educational productivity," that is, with the amount and kind of learning that is accomplished within the school system. This concern has taken the form of increased pressure for the raising of academic standards, and the strengthening of academic curricula, in the schools.

2. These pressures to strengthen the academic curricula in the schools are exerted on a comprehensive educational system which has not emphasized college preparation, and whose personnel, systems of teacher training, and educational philosophies are not easily adapted to the new goals.

3. The interest in new technologies and organizational forms in education is a characteristically American response to a challenge to increase production by transforming labor-intensive into capital-intensive enterprises.

The national discussion that has gone on in recent years about the quality and character of American public education is conventionally linked to the shock of the Soviet success in space exploration and rocketry, marked by its first successful satellite put aloft in 1956. Behind this, of course, lies the Cold War competition, a competition which generates special worry about our pool of technically trained manpower and the relative merits of the Soviet and American school systems. But pressures for higher standards in American education would have developed even if the Soviets had not challenged us widely on scientific and military fronts. The more basic sources of the new emphasis on the content of public education lie elsewhere (Trow, 1961).

They lie first in the character and development of American secondary education. In the fifty years between 1880 and 1930, the numbers of students in public high schools in the United States roughly doubled every decade, rising from one hundred and ten thousand to nearly four and a half million. And the new secondary education that emerged during those years was shaped both by the enormous increase in the numbers of students, and by their social characteristics. Many of the new students were in school unwillingly, in obedience to the new or more stringent state compulsory education laws; many came from poor, culturally impoverished homes and had modest vocational goals; many were the sons and daughters of recent immigrants, and seemed to observers very much in need of "Americanization." These new students posed new problems for secondary education; and these problems, and the answers which they engendered, transformed public secondary education, its philosophy, and its curriculum.

With schools full of children for whom the traditional content and purpose of the secondary school curriculum were irrelevant, educators needed some rationale and justification for what they were doing. And what they were doing was trying to teach something that promised to be of some use to these terminal students, in ways that would hold, at least fleetingly, the interest of indifferent students whose basic interests lay outside the classroom. It was a concern for the interest in learning which one could no longer assume in the student, but had to engender in the school, that lay at the heart of W. H. Kilpatrick's The Project Method (1918), and before that, underlay the importance of motivation in John Dewey's writings.

Commenting on the influential National Education Association Report of 1918 entitled Cardinal Principles of Secondary Education, a report strongly influenced by the writings of Dewey and responsive to the new demands of mass secondary education, James Conant (1959) observed:

> Confronted with a "heterogeneous high school population destined to enter all sorts of occupations," high school teachers and administrators and professors of education needed some justification for a complete overhauling of a high school curriculum originally designed for a homogeneous student body. The progressives with their emphasis on the child, "on learning by doing," on democracy and citizenship, and with their attack on the arguments used to support a classical curriculum were bringing up just the sort of new ideas that were sorely needed.

The creation of a system of mass secondary education could not be simply the extension of the old elite secondary system; it had to be different in function (terminal rather than preparatory) and in organization (public and locally controlled, rather than private tuition and endowed schools). Moreover, it needed its own curriculum and its own teacher-training programs and institutions, because the sheer number of secondary teachers required by mass secondary education was far beyond the capacities of the traditional colleges to supply, as they had supplied the older tuition academies.[1] In the old academies, the principals and masters were products of the colleges, and often went on to teach in the colleges; there was no sharp break between the academies and the colleges since they taught roughly the same subjects to the same kinds of students. This was no longer possible with the new terminal public high school; the students were different, the curriculum was not preparation for college, by and large, and new departments of education and state teachers colleges were created at least in part to train the staffs of these new high schools.[2] These centers of professional education were not identified with the older, elite traditions of higher education, but created their own traditions of education for life, for citizenship, for useful tasks, the traditions, that is, of the mass democratic terminal secondary system that came to full flower between 1910 and 1940.[3]

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[1] The number of public high school teachers increased from about twenty thousand in 1900 to over two hundred thousand in 1930. (U. S. Office of Education, Biennial Survey of Education, 1928-1930, pp. 8, 222.)

[2] On the upgrading of normal schools to the status of four year state teachers colleges, and the establishment of departments of education in other colleges and universities in the decades before 1920, see Frazier and Evenden, *et al.* (1935).

[3] "During the first half of the present century, while many liberal arts colleges turned their backs on the problems of teacher education, legal requirements for certification were established in nearly all states.... [W]hile the liberal arts colleges were preoccupied with other things, while they ignored the problems of teacher education, a like-minded group of school administrators and other professional educators came to agreement among themselves on the necessity for professional preparation for teachers and transmitted their convictions into law. It was during this period that the educators became imbued with a new philosophy of education, one far removed from the academic traditions of the liberal arts colleges." (Woodring, 1957, p. 23; Borrowman, 1956.)

Since the end of World War II, American higher education has been undergoing a very rapid expansion which in many ways resembles the growth of mass secondary education in the first half of the century. As recently as 1940, our colleges and universities enrolled only about one and a third million students, who comprised about 15 per cent of the population of college age, the eighteen to twenty-one year olds. (The same proportion of the high school age group--the fourteen to seventeen year olds--were enrolled in high school in 1910.) By 1961 the number earning credits in our colleges and universities had increased to nearly four million. This threefold increase resulted almost completely from increasing rates of enrollment, since the population of college age was almost exactly as large in 1940 as in 1960. The difference is that whereas the college enrollments in 1940 comprised about 15 per cent of the age group, in 1960 that figure was about 37 per cent, and increasing at an average of more than 1 per cent a year (American Council on Education, p. 233).

The growth in numbers will be even faster in the decades to come, for, in addition to rising enrollment rates, the rise in birth rates since World War II will shortly greatly increase the pool of college age youngsters. Estimates of college enrollments in 1970 vary between six and eight million; the most plausible estimate, based on projections of present trends, is about seven million.

The growth of college-going is transforming what has, for fifty years or more, been predominantly a system of mass terminal education into one that is increasingly asked to prepare large numbers, and even majorities, of students for college work. In 1962 well over half of all high school graduates went directly on to some form of higher education, and in some parts of the country the proportion was very much higher. (American Council on Education, p. 253.) Thus, this transformation is being imposed on the secondary schools by forces external to them.

In the course of this transformation the high schools find themselves having to deal not only with a different kind of student, but also with a different kind of parent. During the formative years of the mass terminal secondary system in the United States, the teachers and educators who were building the system were dealing by and large with parents who themselves had gone no further than grade school. These people, many of them immigrants or of rural origins, whose children were going no further than high school, had neither the competence nor the motivation to be greatly concerned with the high school curriculum. And the debates about secondary education were carried on largely over the heads of these parents, among the professionals themselves, and between the educators and sections of the academic community. But, increasingly, secondary school people are dealing with educated parents of preparatory students, who possess both the competence and the direct motivation to be concerned with the character of their children's secondary education. As recently as 1940, three American adults in five had never been to high school, and only one in four had completed high school (Bogue, 1959, p. 343). By 1960 three in five had been to high school, and over 40 per cent were high school graduates.[4] By 1970 over 50 per cent will be high school graduates, and by 1980 it is estimated that figure will reach 60 per cent (Bogue, p. 779). Parents who have been through high school, many of them through some years of college as well, feel more competent to pass judgment on the secondary education of their children, and are less likely to accept passively and on faith the professional recommendations of school administrators, educators and counselors. It is this rapidly growing group of educated parents whose children are going on to college which provides both the audience and the support for the "academic" critics of the secondary school and its curriculum. There is every reason to believe that their interest will grow as their numbers increase, and as competition among their children for the better college places becomes sharper.

The increased numbers of students going on to college, the resulting heightened interest among academic men in primary and especially secondary education, the increasing concern with scientific and technological manpower as an element in national power and economic growth, the large and growing numbers of educationally competent parents--all of these and other forces have converged on the schools since World War II as a set of cumulative pressures toward the improvement of the quality of education.

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[4] Between 1940 and 1959, the average educational level of the whole adult population rose from 8.4 to 11.0 years of schooling completed (U. S. Bureau of the Census 1959, p. 5).

This is not to suggest that the pressures for the reform of education emanate only from the academics and the parents of college-bound children. It is true that the wave of post-war criticism of the quality of American education arose out of and has remained centered on the education of the academically able and talented, in part in reaction against the dominant concern of professional education in the preceding decades with the "average" student, for whom a strong emphasis on academic work was presumably not appropriate. But in the past few years these demands for the improvement of education have been reinforced by the revolution in race relations. There has been a growing awareness of the relation between the quality of education, and the high rates of dropout, delinquency, and unemployment among Negro youth. Better education, and in the basic disciplines, is now one of the demands of civil rights groups and their supporters.

The responses to these pressures over the past decade have taken two distinct forms. One has been a variety of efforts to improve American education by working through the ordinary classroom teacher. Among these has been the work, largely undertaken by college and university professors, to reshape the school curriculum, first in the sciences, and increasingly in foreign languages, English and the social sciences, through the preparation of new syllabi, texts, and other teaching materials. All these efforts have been aimed at introducing new knowledge and conceptions into the classroom, and bringing what is taught there closer to the academic disciplines as they are taught in the colleges and universities. Along with these reforms of the curriculum have gone efforts and proposals to strengthen the academic preparation of teachers, to ensure that they have been educated in what they teach, and that they teach only what they know. Some states have revised their credential requirements to require most new teachers to have a subject matter major. New and wider opportunities have been provided for older teachers to continue their education in their subjects by attendance at National Science Foundation supported summer institutes. Working in the same direction, proposals have been made to reform teacher training to emphasize academic work and supervised teaching. Some schools and departments of education have tried to raise the intellectual quality of people recruited to teaching by raising their admissions requirements.[5] Not all of these efforts can be attributed to the widespread concern about education that developed after World War II, but certainly the new climate of criticism has reinforced and accelerated these efforts. What they all have in common is that they are addressed to the education and training of the ordinary teachers, and to the character of what they teach.

The new media and modes of instruction, notably classroom television, teaching machines, and team teaching, similarly represent responses to the pressures for the strengthening of the academic side of American education. But they differ from the efforts to upgrade the training of teachers and the school curriculum in that they represent efforts to strengthen education, not primarily through the teachers, but, to a considerable extent, independently of them. They are, I suggest, a product of the disparity between what is widely felt needs to be done by way of improving the quality of academic work in American schools, and the possibilities of doing it quickly by improving the performance of a million and a half classroom teachers, most of whom were recruited to and trained in a system of mass education which did not prepare the great majority of its students for higher education.

Efforts to raise the quality of education by strengthening the school curriculum and teacher training--that is, through labor-intensive efforts to raise the quality of the teacher's performance in the classroom--are agonizingly slow to take effect. They are slow in part because the enormous institutional complex represented by the schools and departments of education, credential requirements, and the like, has great inertia and powers of resistance to innovation. The men and women who staff the teacher training programs, and lead the state departments of education and the state and national educational associations, are, by and large, the people (or students of the people) who with great dedication and devotion created the system of mass terminal secondary education, and who hold with almost religious fervor the values associated with terminal education, the values of education for life and for useful work that characterized American secondary education for fifty years or more. Many of them are less than enthusiastic about the new emphasis on academic performance and the changes it is bringing to the curriculum and to instructional methods. Commenting on a National Education Association report on new approaches to instruction, Fred Hechinger observes that:

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[5] On the reforms of the curriculum, see the essays in The School Review (Spring, 1962). Proposals and current projects looking toward the improvement of teacher education can be found in Koerner, 1963, and Woodring, 1957. On programs of inservice education, keyed to curriculum reforms, see The Bulletin of the National Association of Secondary School Principals, November, 1963.

> The startling fact--as one looks over the list of innovations covered by the report--is that few, if any, of the experiments were begun by public school educators or, having been started, welcomed by the rank and file. Team teaching, TV and the use of non-professional teacher aids appear to have sprung from Ford Foundation research; the mathematics reform movement was initiated by the Carnegie Corporation, the physics, chemistry and biology curriculum reform was born at the universities, and not predominantly at their schools of education.[6]

But over and above the inertia and resistances of teachers and educators, efforts to upgrade the curriculum and the education of teachers are slow to take effect because they are aimed at raising the level of performance of a million and a half teachers, whose academic qualifications and abilities are relatively low as compared with other professional and college-educated groups.

Many high school teachers of academic subjects are inadequately prepared in the subjects they teach.[7] And, with respect to abilities, the pattern of negative selection in teaching below the college level has been abundantly documented. The extensive studies done with national samples by the Educational Testing Service and others show that students who major in education score lowest on comprehensive tests of verbal and mathematical competence as compared with majors in almost every other field. (Chauncey, 1952; Wolfle and Oxtoby, 1952; Wolfle, 1954.) In a review of some sixteen studies of the ability of teacher education students, extending from 1928 to 1958, and in many different populations, North (1958) found without a single reversal that teacher education students were in general less able academically than other college students. Moreover, among those who go into education, there is a further negative selection of those remaining in classroom teaching. A follow-up study done in 1955 by Thorndike and Hagen of ten thousand Air Force cadets who had taken comprehensive intelligence and achievement tests during World War II shows that of all those who went into public school teaching after the war, "those who were academically more capable and talented tended to drop out of teaching and those who remained as classroom teachers in the elementary and secondary schools were the less intellectually able members of the original group." (P. 10.) Both the men who remained in education as administrators, and those who had left education completely, showed more academic ability on the Air Force tests than did those who stayed in the classrooms.

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[6] The New York Times, Western Edition, October 16, 1963. One study done in Ohio in the early '50's found that "teachers were more likely to resist significant curriculum change than either administrators, students, or parents." (Urick and Frymier, 1963, p. 108.)

[7] A study conducted by the National Council of Teachers of English, not yet published, of over seven thousand high school English teachers whose average experience was nine years, reports that "only 50.5 per cent

The negative selection to teaching is even more marked for men than for women, and this has special significance for college preparatory work in the high schools, where men comprise about half of all teachers. North (1958), reporting on the results of the 1956 College Qualification

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had majored in English. One-third majored in a field with no relationship to English. Two-thirds rated themselves as poorly prepared to teach composition and oral skills, 90 per cent said they were poorly prepared to teach reading, and almost 50 per cent said they were poorly prepared to teach literature." (The New York Times, Western Edition, December 30, 1963.) A study by the U. S. Office of Education in three states showed that 39 per cent of the teachers in the study who were teaching one or more courses in high school mathematics had not had the calculus or a more advanced course in mathematics, while 7 per cent had had no college mathematics at all. (Brown and Obourne, Tables 20 and 22, p. 46.) In 1956-57, 35 per cent of California students in mathematics classes were being taught by teachers who had neither a major nor a minor in math. (Kershaw and McKean, 1962, Table 13, p. 91.)

Test, which was administered to more than twenty-four thousand freshmen in thirty-seven colleges and universities across the country, notes that:

> Norms for college freshmen in programs leading to the degree in education are given for a group of 274 men and 583 women. Comparison of these norms reveals that in the education group about 80 per cent of the men and about 60 per cent of the women had scores below average on the general norms. In contrast, only about 40 per cent of the freshmen in programs leading to the B.A. degree ranked in the lower half of the general norms (p. 283).

The much lower incomes of teachers, as compared with school administrators, with men who leave education, and with most other occupations requiring a comparable amount of education, account for much of this unfortunate pattern of recruitment and retention of male teachers. Moreover, the relatively low status of teaching below the college level, which is both a cause and a consequence of the low salaries, also helps to explain why teaching attracts and holds too few of the most able men. And while teachers' salaries are rising, it is unlikely that the gross differentials in pay and prestige between high school teachers and other occupations requiring a college education are likely to be significantly narrowed in the near future.[8] On the contrary, there is reason to fear they may be widened. The continued extension of opportunities for higher education to able students, through public and private scholarships, the expansion of public higher education, and the like, offer able young high school students a wider range of educational and occupational alternatives, many of which carry greater prestige and higher incomes than does teaching. In the past a career in teaching was often the only intellectual occupation (aside from the ministry) open to serious young boys from farms and small towns; and the local normal schools or state teachers colleges were often the only educational avenues of mobility open to such boys. There are proportionately fewer boys from farms and small towns today, and wider opportunities for them, as for city youngsters, in higher education. Able young men and women with academic interests are more likely to be drawn to school teaching when their opportunities are limited by poor or immigrant or rural backgrounds, by scarce employment, or by the difficulties or expense of getting a higher education in other than a teacher training institution. The able students whose horizons and aspirations were formerly bound by a local normal school now have wider opportunities and higher aspirations. This, together with the continued growth of the "intellectual occupations," is almost certain to make the competition for able men sharper in the years to come.[9] Our society's demands for scientists, engineers, technically trained people of all kinds, appear insatiable, and the rewards for work in those fields are usually considerably more generous than for school teaching. Of even greater importance, the very rapid expansion of higher education currently under way, and the enormous demands for college teachers that it creates, constitute perhaps the strongest set of competitive opportunities for young men and women who want to teach. Junior colleges, in particular, draw a substantial proportion of their faculties directly from the high schools, and the more academically oriented teachers, at that. The continued expansion of the colleges and junior colleges cannot help but impoverish the teaching staffs of the high schools.

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[8] Over the six years between 1955-56 and 1961-62, the average salaries of all public school teachers, principals, and supervisors rose by 37 per cent. But during the same period, the salaries of college teachers in all ranks rose by about as much, and in most categories of institutions, by more. (Fact Book on Higher Education, pp. 105, 106, 239.)

Substantial increases in pay for public school teachers may ameliorate, but are not likely to reverse, the pattern of recruitment of academically less able men to high school teaching. Thus, no matter how teacher education and secondary school curricula are reformed to strengthen the college preparatory function of the high schools, a substantial part of the actual teaching itself will be carried on by relatively poorly paid, low status, and academically less able people. These things may not have mattered so much when secondary education was largely terminal; at least it can be argued that qualities other than academic ability--for example, a deep interest in young people and skills in working with them--are more important for teachers of students whose interests are not academic or intellectual.[10] But that can hardly be claimed for teachers of college-bound youngsters, whose success in college will rest very heavily on the knowledge and intellectual habits they acquire in secondary school.

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[9] Between 1940 and 1950, "professional, technical, and kindred workers," which is the census category for the occupations that require at least some part of a college education, rose from 7.5 per cent of the labor force to almost 12 per cent. In the decade 1950-1960 that category grew by 48 per cent while the whole labor force was growing by only a little over 10 per cent. It is estimated that the category is increasing during the '60's by an additional 40 per cent, from about 7.2 millions to about 10.4 millions. (Manor, 1963, Table 4; U. S. Bureau of the Census, 1960, p. 74, Table D72-122; Fact Book on Higher Education, p. 146.)

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Consider the lot of the high school teacher today, as described by the Commissioner of Education (Keppel, 1963):

> In many cases, his salary and social status are still only slightly above those of an office worker. The public tends to consider him neither a scholar nor a man of affairs, but a compromise between the two who could probably succeed at neither. His working day, while theoretically short, is packed with teaching assignments, corridor patrol, or lunchroom supervision. His chances for advancement, either in rank or salary, are limited and usually require him to leave the classroom, where he is badly needed, to enter administration, which also has a shortage of qualified men.
>
> He has little academic stature compared even to the lowliest college instructor. His contacts with the main stream of American intellectual life are limited, if not non-existent. If he is conscientious, he may spend many after-hours correcting papers or preparing for future classes. More often, he will find that he has to pump gasoline at a filling station. During the summer, he frequently has to work at a non-teaching job rather than take additional studies that he can afford only by starving his family. The university courses he does take are likely to be chosen for their accessibility and economy (or for their effect on the salary schedule) rather than for their contribution to his knowledge in his teaching field. When he looks at the years ahead, he often sees a future of mediocrity and stagnation rather than one of achievement and challenge. The contrast to many other walks of life is all too evident....Under these circumstances it is little wonder that the high schools have not attracted their proper share of able young men and women with a commitment to teaching. It is not surprising, either, that many new teachers come to their jobs with inadequate preparation either in academic knowledge or professional skill. Nor should we marvel that a discouragingly large proportion of the sixty-seven thousand who begin high school teaching each year soon leave it for greener fields.

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[10] Although many critics argue that it is precisely the weaker students who need the most serious attention to academic subjects in secondary school. See the publications of the Council for Basic Education.

It is significant that this description is part of an article in which Keppel recommends programs which offer the Master of Arts in Teaching to a relatively small number of very able students in elite colleges and universities, such as Harvard, Oberlin, and Reed. The graduates of the program, Keppel reports, seem to be "on the way to well-paid and responsible positions that make education an attractive career for the able and dedicated candidate" (p. 253). It is clear that Keppel sees these programs as a way of recruiting larger numbers of students from the strong selective undergraduate colleges of arts and sciences which have not in the past "provided their fair share of potential teachers" (p. 248). Much the same concern with improving the quality of education by recruiting relatively small numbers of highly able teachers who could occupy posts of special responsibility and reward lay behind Keppel's early interest in team teaching. Martin Mayer (1961, p. 388) quotes Keppel to the effect that Harvard's interest in team teaching was in its effects on teacher recruitment and utilization, effects it could achieve by offering really able recruits (like the products of the Master of Arts in Teaching programs) a "career"--a hierarchial series of steps in teaching--comparable to that offered by other professions. As Keppel put it,

> If the schools were organized in teaching teams, I could go to Amherst and say, "You will start as an intern, and you can work up to Master Teacher--at a salary, I'd hope, of ten to twelve thousand dollars a year." We have a million and a quarter teachers. I'm prepared to believe that the American people will pay ten or twelve thousand a year to two hundred thousand--but not to a million and a quarter.

In a sense, all the new modes of instruction I have been discussing--programmed learning, classroom television, as well as team teaching--are efforts to use to best advantage the elite of talented and well-educated teachers that Keppel wants to recruit or identify. These innovations all involve the creation of a hierarchy of skill and reward among teachers, coupled with a division of labor and function, aimed at increasing the educational impact of the minority of most able teachers--the most talented, energetic, committed, and academically well-grounded.

Stiles and Chandler (1962, p. 260) make the connection between the new modes of instruction and the development of a hierarchy among teachers explicitly:

> Urban schools in the future will offer multiple opportunities for professional service, specialization, and advancement. Although it is to be expected that guild organizations will exert persistent pressures to prevent the professionalization of teaching services in city systems, it is highly probable that differentiations will be developed in the quality and utilization of teaching competence that will permit outstanding teachers to be rewarded for professional competence and contributions. Examples of such recognition of quality teaching are already available in television teachers, instructional team leaders, and specialist teachers in some school systems. In the future, it is likely that the uniform scale salaries that educational guilds defend so vigorously will apply only to the lowest echelon of teaching. Others who prove their professional competence will be able to advance within the function of teaching to higher assignments that carry greater professional responsibility and greater financial rewards.

Stiles and Chandler do not distinguish among the several new approaches to instruction in terms of the kinds of elite groups they create within teaching; they refer rather casually to rewarding outstanding teachers who can "prove their professional competence." But teaching machines and classroom television differ from team teaching in this respect, in ways which may partly account for the relatively easy acceptance of television and teaching machines by the schools, as compared with the spotty and slow progress of team teaching.[11] One difference is that teaching machines and television have built into them fairly clear technical skill criteria for differentiating among teachers. Another is that the elite teachers--the programmers and television teachers--are rarely the classroom teacher's colleagues, and do their work outside the teacher's own school. The "differentiation" between elite and ordinary teachers arising out of programming and television develops in the occupation, but typically not within any given school. By contrast, team teaching brings these invidious distinctions into the school, where the selection of the master teacher or team leader runs into all the difficulties involved in assessing the processes of classroom teaching. Teachers and their guild organizations are traditionally highly suspicious of efforts to differentiate among them on the basis of their ability as teachers. We can see this in the enormous resistance teachers put up to schemes for merit pay, and the tendency to link pay differentials to criteria other than the invidious distinctions among better and poorer teachers--most commonly to seniority and credit hours in schools of education.[12] All three of the new modes of instruction distinguish among elite and ordinary teachers, but as compared with the visible technical skills of the machine programmer or television teacher, the distinction within a team of teachers is likely to be felt as illegitimate, invidious, and arbitrary, since the basis of the distinction is not a technical skill, but merely somebody's judgment of how able one teacher is as compared with his or her peers. And it is not surprising that in some cases where team teaching has been introduced, the hierarchial principle has been successfully resisted; the teams, after a period of floundering, have "organized themselves as a group of subject-matter specialists or in patterns as close as possible to those prevailing in the self-contained classroom" (Mayer, p. 390).

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[11] The acceptance of television and teaching machines is also due in part to the vulnerability of school administrators to external demands for greater efficiency and higher productivity in education. (See Callahan, 1962.)

The impact of the new forms of instruction will be conditioned by the characteristics of the craft on which they impinge.[13] Among these characteristics are three of special importance:

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[12] An NEA study done in 1960 showed that between 1938-39 and 1958-59, the proportion of large school districts studied having a merit-pay plan in operation had fallen from 20.4 per cent to 6.2 per cent. Of the districts that had tried such a plan but had dropped it, a third reported they had done so because of the difficulties of evaluating teachers; another third because the plans had created dissension among teachers. (NEA Research Bulletin, 1961, pp. 61-62.)

[13] For a number of these ideas I am indebted to a penetrating essay by Dan C. Lortie.

1. The indeterminacy of the teacher's product;

2. The relatively low visibility of the teaching process;

3. The limited degree of control which teachers have over their conditions of work.

The new forms of instruction modify, in their different ways, each of these characteristics of the teacher's job. They affect what teachers do, how they are related to one another, what rewards they can gain from their work, and ultimately, the kinds of people who will be recruited and retained in the classroom. Indeed, it is likely that an important source of the support for these new forms of instruction lies in their potential for reshaping the nature of instruction more directly and more drastically than is possible through the traditional efforts to improve the quality of the teachers themselves or their training.

It is generally recognized that it is extremely difficult to assess the effectiveness of the classroom teacher. Teaching aims to transmit bodies of knowledge, develop habits of logical inquiry and critical reflection, contribute to the child's psychological well being, cultivate social responsibility and "good citizenship," encourage enduring interests--the list can be extended almost indefinitely. Many of these desired outcomes are difficult if not impossible to measure; moreover, the teacher's impact is difficult to distinguish from all the other influences on the moral and intellectual development of the child. And finally, a teacher's most important effects on students may not be visible, and thus assignable, in the short run, but may bear fruit long after the student has left his classroom.

Coupled with the indeterminacy of his effectiveness is the relatively low visibility of his efforts. The teacher in his classroom is insulated both from the general public and from his fellow-teachers and administrators. As Lortie notes, "The witnesses of a teacher's mastery of the processes of teaching are primarily legal minors whose testimony and judgment are somewhat suspect." (Pp. 9-13.) The process of teaching is invisible in another sense, in that it is obscured by all the other forces affecting learning. Even when one observes a teacher at work, the responsiveness or apathy of his students can rarely, with any confidence, be attributed to the teacher.

Nevertheless, teachers, like other craftsmen, seek and find rewards in their work. The societal rewards--in pay and prestige--are typically felt to be deficient, and moreover, as teachers recognize, cannot be closely linked to their effectiveness as teachers, in large part because of the indeterminacy of the product and the difficulties of assigning credit for success. Lortie's research leads him to suggest that, in their search for rewards in their work, teachers substitute "proximate, somewhat assessible goals for the ultimate goals stressed in the rhetoric of educational philosophy."

> The individual teacher works out his own definition of his desired product and monitors his performance in terms of that product definition. Since this process is undertaken individually (and largely without official sanction), it leads to a diversity of product definitions among teachers. One teacher will get his rewards of craft pride from seeing that his classes obtain a high average score on college board examinations where another will influence youngsters to choose teaching as a career. (P. 4.)

While for some the rewards of raising the intellectual capacities, or academic performance, or career aspirations, of their students will be central, for many, their chief rewards lie in their ability to relate to students as persons. And for many, "their pleasure at indications that their students like and enjoy them, and the affective response they obtain" (p. 20) is the chief pleasure they find in teaching, when their own dispositions, training, and the characteristics of their students all work to reduce the rewards from the intellectual and academic content of the teaching itself.

The indeterminacy of the product and the invisibility of the process of teaching both increase the importance of the personal characteristics of teachers for the kinds of goals they set for themselves and the kinds of rewards they seek in the classroom. Insofar as these definitions of success are privatized, they are highly variable, affected very greatly by a teacher's temperament, intellectual ability and training, and his own history of intellectual success or failure. Many teachers have not themselves been liberally educated, nor have they enjoyed or done well in their academic careers. Such people are not likely to find their chief rewards in the intellectual growth of their students, or to see their students' academic achievements as a major goal to be pursued and an important criterion of their own success as teachers. Nor, until recently, have such criteria been strongly urged and supported by school administrators and boards.

One function of educational philosophies is to shape and justify the product definitions of teachers. But the absence of any consensus among educational philosophers about the aims and priorities of education has diminished their influence on what the teachers themselves take to be important. Vulgarized versions of progressivism certainly helped to demolish the authority of the classical tradition, but gave little support to the notion that the distinctive function of the schools is intellectual training (Cremin, 1961). Rather, these versions of "progressivism," most notably the life adjustment movement, tended to justify the private product definitions of teachers, especially those which minimized the importance of academic achievement (Hofstadter, 1963, pp. 299-390).

Underlying the widespread criticism of American education over the past decade is a mistrust of the private product definitions of teachers, and of the educational philosophies, formal and implicit, which legitimate them. The new modes of instruction, reflecting this mistrust, insert themselves directly into the classroom, and take the definition of the product out of the hands of the teachers (and to some extent out of the hands of professional educators), centralizing it and making it more visible. Programmed learning, for example, focuses the student's attention on a body of material to be learned. A student attending to a program of instruction is not at that moment engaged in "interpersonal relations with the teacher," or in a group discussion whose character and direction are far more vulnerable to the teacher's notions of success and to his private search for gratification in his work. Insofar as the programs themselves are written by subject matter experts or college professors, their product definitions are introduced more directly and forcefully into the classroom than has heretofore been possible. (And to an important extent, programmed instruction not only substitutes one set of definitions of success for whatever set the teacher may have held, but by directing the teacher's as well as the student's attention to the program, may in fact modify the teacher's conceptions of desired outcomes, and thus his sources of intrinsic gratification in his work.)

Similarly with televised courses: television makes the teaching process widely visible,[14] and the televised teachers themselves more likely to be subject-matter specialists, with aims closer to those of their counterparts in the colleges, than is true of many of the teachers into whose classes their programs are piped. It is true, as Lortie notes (p. 23), that television could conceivably become an instrument of the individual teacher who uses it very much as teachers use films today, to supplement the teacher's own instruction and demonstration. But this, in his view, is unlikely:

> The high costs involved in equipment and technical personnel, however, make it more probable that television facilities and transmission will be centralized at the school system level or in larger units of cooperating systems. Under such circumstances, television will become a central office function and it is also likely that with time, it will lead to a specialized role of television instructor. Such television becomes an instrument for projecting the teaching of one teacher into many classrooms.

The televised teacher is very far from representative of teachers as a group, but much closer in temperament, talent, and training to the models projected by the critics of contemporary education. He or she is more likely to have the grasp of the subject demanded by the curriculum reform groups, a sense of the structure of the discipline called for by Bruner, and the creativity and imagination in presentation admired by Martin Mayer. Unworried by discipline problems, with time and resources for scholarly preparation unknown to the classroom teacher, and debarred from the rewards flowing from personal relationships with the students, the televised teacher, more nearly than the great majority of classroom teachers, can meet the demands for intellectual challenge and academic achievement that accompany the growth of mass higher education and the concomitant transformation of secondary education.[15] And similarly, the master teacher or team leader, at least in theory, would be a subject-matter specialist, abreast of advanced work in his or her discipline (Shaplin, pp. 211-217).

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[14] One observer has expressed concern precisely about the increased visibility of teaching by television, which he sees as inhibiting the presentation of controversial or original material. For this and other criticisms of televised teaching, see Goldman, 1961, pp. 16-22.

Conclusion

This paper has argued that the lively interest in new media and modes of instruction in the past decade is in large part a response to a heightened concern on the part of parents and educators with the quality of primary and secondary education, and with the academic preparation of the growing numbers of students who enter some form of higher education. Among the variety of responses to the increased concern with the quality of education have been efforts to strengthen the preparation and training of teachers, and efforts to bring school curricula more closely into line with the currents of thought and work in the colleges and universities. But another set of responses has taken the form of efforts to raise the quality of instruction not through the classroom teacher but around him, by introducing new bodies of material, and new ways of presenting it, directly into the classroom through programmed instruction, television, and the master teacher.

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[15] However, some observers have doubts regarding the extent to which watching a "master teacher" on television will help the classroom teacher's own teaching effectiveness. "....the television teacher often pitches his presentation above the level of the classroom teacher's competence, showing the latter at a disadvantage and exposing him or her to student questions that he cannot answer. This kind of embarrassment doesn't necessarily motivate improvement; rather it increases tensions and the fear of threat to the classroom teacher's authority. Resistance rather than learning may derive from this experience; the dynamics of the individual situation are not taken into account in the more optimistic predictions." (Fritz, as reported by Asheim, 1962, p. 27.) What is needed is precisely research on "the dynamics of the individual situation."

These new approaches to instruction are, each in its own way, a response to the pressures for upgrading the quality of American education in the face of the very great difficulties of raising the quality of performance of the great mass of American teachers. In addressing themselves to the technology and organization of production, rather than to the level of skill or effort of the individual workers, they represent a measure of rationalization of production which involves, at least to some degree, the transformation of a labor-intensive craft into a capital-intensive industry.[16] And in this respect, these innovations represent the application to education of a characteristically American tendency to circumvent shortages of labor or skill by the more efficient utilization of what labor or skill is available.[17]

The relatively lesser interest of English (and other European) educators in the technical and organizational innovations I have been discussing lies, I believe, in the dual educational systems of those countries.[18]

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[16] An English economist, commenting on the use of teaching machines and television in American schools, observes:

> In these and other experiments a complex procedure of replacing labour by machines, and using machines to subdivide the teachers' tasks is proceeding just as it did in Adam Smith's pin factory. The unpleasantness of individual experiments to those of us more accustomed to the easier, more slipshod labour-intensive methods of ordinary education should not blind us to the historical trend which is inevitable in a society where capital is more abundant (relatively) than skills. (Vaizey, 1962, p. 80.)

[17] On the relation of scarcities of labor and skill to technological innovations in 19th century America, see Habakkuk, 1962.

[18] See, for example, Educational Television, Independent Television Authority (British), n.d. It is interesting that they see the use of television primarily as a classroom supplement rather than for basic instruction.

> In the United States television was virtually drafted into the depleted ranks of the teaching profession and had to take the place of the missing or unqualified teacher. For many American children and students, learning some subjects through television has been their only chance of learning them at all. With us, the teaching shortage may be severe,

Typically, in European countries, secondary education is organized in two distinct systems, one which prepares students for the university or its equivalent, the other which is an extension of primary school and is terminal. Typically, university graduates teach in the preparatory system, while products of secondary education and teacher training institutions staff the other. In the elite preparatory system, there is a very high concern with the quality of instruction; this is dealt with in traditional labor-intensive ways, through a continual vigilance over the academic preparation of the teachers, the maintenance of high standards through nation-wide examinations, and a continual reconsideration of the curriculum. In the mass terminal system (as in the bulk of American secondary education before World War II), there is simply less concern about the academic quality of instruction. The marked difference in the quality of education offered in the two systems in England is revealed dramatically in recent data which show that between the ages of eleven and fifteen, students with the same initial scores (at age eleven) on tests of academic achievement diverged markedly, students in the grammar (preparatory) schools improving their scores, while students in the secondary modern (terminal) schools fell in achievement (The Robbins Report, Appendix I, Part II, p. 50).

So long as American secondary education was predominantly terminal, a concern for academic performance could be confined to the selective academic high schools or those parts of comprehensive schools which prepared significant numbers of students for selective colleges, and could be met through traditional methods. It was only the transformation of secondary education from a predominantly terminal into an increasingly preparatory system, coupled with the increasing selectivity of colleges and universities, that broadened the extent of concern with academic performance. This concern, in the face of an institutional system which had changed its

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> but it has never led teachers or the teachers' organizations to seek the aid of tele-teachers. Indeed, when the first school programmes were launched in 1957, ...it was really in spite of the majority of teachers, and only on the strict understanding that television would not take over the teacher's job and infiltrate into the profession. (Ford, 1962.)

functions but not its philosophies, or the characteristics and preparation of the bulk of its teachers, led to the current interest in raising the quality of instruction through the new media and modes of instruction.

It is important to distinguish the different roles the new technology plays in different school systems. In some, the classroom teacher is subordinated to the new methods; in others, they appear as ancillary aids employed by the classroom teacher. The question is essentially where authority lies regarding the employment of the new methods--in the hands of the classroom teacher, or in the hands of administrators in the state or district offices. I suspect that where education is weakest, the new methods will be extensively employed to replace inadequate classroom instruction;[19] where standards are highest, where teachers are more able and better trained, the traditions of education as art and skilled craft are more likely to persist, and the new methods used to supplement classroom instruction. Both modes of use can be seen in American education, but in different situations, and with different consequences for the teacher and for education generally.

The "technological revolution" in education involves forces working both to raise and to lower the status of teachers. Where teaching remains a craft, where the skills, training, and abilities of classroom teachers are strengthened and cultivated more intensively, and where they are in control of the new technology of instruction, teaching will assume more of the characteristics of a profession, and the teacher's activities will be governed more by professional norms, collegial rules, and his own discretion, than by orders from above. By contrast, where the new media come to play a major role in instruction, where they supplant rather than come under the authority of the classroom teacher, the teacher will have less and less the characteristics of a professional. In the short run, this seems likely to be the more common tendency in elementary and high schools.

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[19] Each day, courses in South Carolina history, Algebra 2, French 1, Physical Science, College Algebra, Plane Geometry, French 2, and Electronics are also piped on tape to almost one-third of all the high school students in the state. By 1970, every public school, white or Negro, will be hooked into the network.

(The National Observer, November 12, 1962.)

The more centralized and extensive the planning of instruction through the new media, the more important will be the planning and administrative staff. These staff people already hold statuses (and earn salaries) higher than those of classroom teachers. The gap will be widened, and the administrative staff will come increasingly to include people directly involved in teaching (as television or "master teachers"), or in developing instructional materials (programmers). But in addition to the widening of status differentials, the rationalization of instruction will centralize power as well. The classroom teacher now has relatively narrow discretion in the shaping of the curriculum and the choice of materials. The new media, if governed from above, will further narrow the scope of his discretion. By thus further reducing the calls on him for other than routine skills and custodial functions, the new media will further lower the status of the non-elite teacher.

In any event, the consequences of these innovations will certainly be greater than their intended effects on the quality of instruction. They are likely to affect the structure of the teaching profession, replacing a unitary status by a hierarchy of professions and statuses; they may affect the rewards of teaching by reducing the scope for private "product definitions," and standardizing criteria of success; and ultimately they will affect the patterns of recruitment to teaching by establishing different tracks for different groups and strata within education. But the cumulative effect of these consequences on the quality of education in America remains to be seen.

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CHAPTER XI

THE IMPACT OF THE NEWER MEDIA ON OUR TOTAL SOCIETY

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The impact of printing on society was infinite in its ramifications, which are still continuing. Viewed comprehensively, however, they can be summarized as enhancing the importance of the individual while widening the world of which he is a part.

The impact of electronic communication of information on society is likewise infinite in its ramifications, which is only beginning. Viewed comprehensively, they also can be summarized as still further enhancing the importance of the individual while immensely widening the world of which he is a part. Hence, these two major turning points in human history deserve comparison.

On the other hand, there are differences so drastic between printing and electronics that one may wonder if their consequences could possibly move in similar directions. Marshall McLuhan, for example, contends that whereas printing led to cultural explosion--movement outward from the centers of civilization to unknown realms electronic communication is leading to cultural implosion--the unification of society and of knowledge itself into a single commonwealth. Our thesis shall be that, notwithstanding the dramatic contrasts between the older and newer media, the effects of both on society are to elevate the individual and widen his world. The direction of development is similar, but of course contemporary exaltation of self-consciousness and of global awareness differs in kind and degree from what began half a millennium ago. Thus, contrasts between the older and newer media and their characteristic impacts must be explored before our thesis can be confirmed.

Before writing and reading, there were no media of communication. Before printing, there were no mass media. Any medium is both a help and a hindrance to communication. In the tiny, pre-literate tribe familiar to anthropologists, all communication is direct and immediate among those within earshot and eyeshot of each other. It does not extend beyond these in space, and only meagerly in time. Knowledge--being imparted orally and hence subject to continual loss--cannot accumulate beyond the limited amount which the old can remember and tell the young. Hence the growth of culture has heretofore seemed to depend on the development of writing and reading. No one questions the gain, but that literacy can also be an impediment only emerges from reflection.

Awkwardness of writing and reading

With the coming of electronic media of communication, literacy is no longer a requisite for communication beyond the present audience. The endless consequences of this simple fact for education and for world civilization are becoming apparent more rapidly than did the consequences of the invention of printing.

Education--even before the invention of printing--has been identified with books. It has largely been conceived as the deliberate transmission of already-existing knowledge, which has been recorded and stored in books. Learning to read--the sine qua non of the first grade of school--has therefore in every generation had to precede acquisition of the knowledge stored in books or other printed media of communication.

Fundamentally, writing is a means of transforming auditory information into visual information; reading, the process of transforming it back again. Learning to read is an arduous, lengthy and expensive process. Hence, it is not remarkable that most of mankind remains illiterate to this day. Neither is it remarkable, on the other hand, that most of mankind should aspire to literacy as the key for unlocking the treasury of accumulated knowledge.

Not only is the ability to read and write a laborious achievement, but the transformation of auditory information into print and back again entails several other impediments to the carriage of information over space and time. The writing and printing of messages require time and money, paper and ink, presses and postal service, not to mention the centuries required for invention of pictographs, hieroglyphs, alphabets, musical notation, and other means of signifying sound.

If communication over space and time had been possible without it, writing might never have been invented. The major initial reason why mankind has ever inclined to put words to paper (or metal or stone or wood) has been to transmit messages to audiences absent in time or space. To write a message to another person in his presence may occur and may perform auxiliary functions, such as maintaining secrecy of the message from third parties, but for immediate communication writing could hardly be considered superior to speech.

The auxiliary functions of writing, once it has been learned, however, accrue considerable value. Writing thoughts down may assist, for example, in their clarification to the writer. As James Reston said during the recent long strike of the New York Times, "How can a man know what he thinks unless he can read what he writes?" Recording may impress events or observations more firmly in the mind of the reader, and will obviously preserve memories more securely and accurately than the human organism can. An organized array of knowledge on paper provides more scope and perspective across a mass of items than the mind unaided can grasp simultaneously. Thus, as in the development of other phases of culture, writing has accrued various functions beyond its original task of communication at a distance. Nonetheless, it can be described at best as an inefficient method for recording, storing, transmitting and reproducing information. None of its functions or values need be sacrificed in adopting more efficient means for accomplishing them. Conservatives will cringe, but writing may someday--like armies and navies--be only a relic of the primitive present.

Conservatism of writing and reading

It is characteristic of written messages that, being read at another time or another place, they are not replied to immediately, if at all. Indeed, the greater mass of printed matter is not intended to be replied to by its readers. This unilateral characteristic of printed matter is in practice shared by some of the newer electronic media, as in broadcasting, but electronic communication is not intrinsically unilateral. Instead of communication, the transmission of messages to which no reply is intended or possible might usefully be distinguished as munication. To transmit information to absent audiences, possibly unknown, is thus a mental and cultural feat largely dependent hitherto on the development of printed media.

It has long been observed that for many people any information that is printed carries an aura of authority; it cannot be argued with, only accepted or rejected. Books whose authors are long dead seem in particular to engender vague claims to superiority in some minds. On the other hand, from this basic sense that what is written is detached from particular audiences has also come a traditional root metaphor of science, the underlying assumption that true knowledge as an entity exists independently of listeners or readers who accept it. The legent of the Alexandrine library, in which Greek culture was preserved until the Enlightenment, exemplifies this fundamental concept of recorded knowledge divorced from both its authors and centuries of intervening audiences. Old phonograph records of songs by Caruso likewise evoke a mortality-defying sense of the potential permanence of human performances deserving immortality.

Most human beings are taught--from infancy onward, by thousands of admonitions, acts of protection and expressions of care--to avoid injury and death. Out of these countless tiny incidents is fashioned the powerful instinct to go on living, which they come to regard as born within them, and from which their universal hankering for immortality is elaborated. Groping for means of expressing this desire with more confidence than can be obtained from merely inscribing their names on stones, some men come upon fame. A man then wishes for his name to be spread throughout the earth, for his picture to be recognized anywhere, for the books of history to retell the story of his actions to succeeding ages. An alternative to being written about is to do the writing, not anonymously as in recording simple matters of fact, but with full display of cherished idiosyncrasy. In the past, men with a powerful drive for fame had to be content with the book as apotheosis of self.

But now, with electronic media for recording, transmitting and reproducing, it is plain that for future generations not even the writings of Winston Churchill about himself will compare with the recorded sight and sound of his addresses to Parliament during the Battle of Britain. Hence, instead of taking away any of the conservative functions and values of books and writing, the electronic media may have enriched them.

To the extent that education is viewed primarily as the transferring of information from one generation to the next, or from those who possess knowledge to those who do not, education is a special case of munication in general. If education were only the imparting of information, however, we might wonder why schools did not disappear with the invention of printing, or were not reduced to the mere teaching of reading.

Before printing, it might have been supposed that schools existed primarily for the sake of efficiency in teaching: one teacher could instruct many students simultaneously. Presumably schools and teachers perform functions other than the imparting of information, since they did not merely survive but flourished after the invention of printing. They will similarly survive and flourish in the future. Far from being displaced by the electronic media, the performance of their various functions, including the imparting of information, will almost certainly develop further. But to understand just how this outcome can recur, as it did in response to printing, requires some analysis of the many kinds of communication that occur in schools, between teachers and students, and among students, in addition to the simple imparting of information.

The role of the teacher in learning

The first effect of a teacher on a student normally is to define what is to be studied, i.e., the curriculum. Recognition of anyone as a teacher implies that he possesses not merely the knowledge he imparts but more: that he encompasses sufficient acquaintance with the field of study to select wisely which portions are appropriate for the student before him. This role of guiding the sequence and content of learning is extremely powerful in determining the consequences of education, and hence is always at issue. It may be played, however, in many ways: from dictator to editor to adviser to curator.

In all these ways of influencing what knowledge will be acquired by the learner the image of the teacher as transmitter is evident, however selectively the content is adapted to the learner. In adapting content to the learner, however, the art of assessing just when which learner is ready for which content can be elaborated to unlimited degree. Hence, teaching depends as much on the teacher's understanding the particular nature of the learner as on possessing the knowledge to be transmitted. Here is where face-to-face interaction between teacher and student has hitherto seemed indispensable.

The study of the individual student by the teacher is neither widely nor intensively practiced in schools of any kind. Ironically, it is explicitly recognized and honored most where it is probably needed least, in primary schools, where children are in fact less differentiated from each other in their development than at any later period of their lives. In general, students tend to be classified into groups roughly corresponding with age, the members of which are homogeneous enough to justify exposing them simultaneously to the same selections of knowledge. Any further adaptation of content to match the unique qualities of individuals tends to occur without plan during the interaction of student with teacher or with other students. Yet in the art of matching content with learner over time lies most of the _raison d'etre_ of teaching.

Although not widely practiced in schools, some very advanced examples of elaboration of the role of the teacher as a guide in personal development exist. The best known of these examples is coaching in any field of artistic or athletic performance. Here the emphasis, after the acquisition of basic technique, is no longer on the imparting of knowledge but on the improvement by practice in its use. The coach may or may not serve as a model for the student. His own proficiency in the art may be of value in motivating the student to emulate him, but does not seem indispensable, and is rarely sufficient. A good coach exposes his pupil to many models of excellent performance, enabling him to recognize their differing merits. But what the coach does that is indispensable is to enable the learner finally to appraise his own performance, even during the act of performing, thereby endowing him with greater power to achieve the intended result than would otherwise be possible.

The role of the coach is complex, involving many ways of criticizing and stimulating the performance of the pupil. There is no one best way of playing it; there are probably many successful ways, both with the same learner and with other learners. Perhaps one virtue of a good coach is that he knows whom he can coach best, and under what circumstances. Coaching by definition takes account of the peculiar capabilities of the learner and the peculiar timing and other conditions of their unfolding. It thus seems difficult to generalize about how to coach, other than in the loose sense of stating the objectives. Coaching itself, in other words, is an art like any art to which it is applied. There is, however, one objective of coaching in which the electronic media offer unique assistance.

Electronics enable self-coaching

By its nature, the human organism cannot both perform an action and witness this action simultaneously, even with the aid of a mirror. It can at best flicker rapidly back and forth between action and perception of its own action. During moments of intense concentration on difficult action, it is especially oblivious of itself as an object. Yet is precisely these moments--the heights of performance in any sphere of activity--that are especially prized by both actor and audience. How then is the coach to convey to a pupil just what is going on at those moments? Here is where words often fail as a means for reflecting back to a performer fuller awareness of his own performance. And here is precisely where the movie camera and the tape recorder have already been eagerly pressed into service to supplement the memory and descriptive ability of the coach. Eventually these two devices will be fully integrated by their inventors in a form available for mass use. As yet they have not been. The sound movie is awkward and expensive, and cannot play back instantly what has happened during a practice session. The cheapest available video recorder so far announced is still financially out of reach of the ordinary individual and of most schools, although it has been in use in broadcasting for several years. Well before the end of the century, however, people will be able to observe themselves in full color and sound immediately following any performance. And in thus having available an inclusive audio-visual record of behavior, they will be able to derive more value from coaching, to learn faster and better how to shape their own performances--hence, finally become independent of coaching--than ever before.

Instead of attending schools and waiting in turn for limited attention from coaches on the staff, they may thus be able to receive coaching at a distance--e.g., by mail--from superior coaches, who can schedule their coaching with greater efficiency, and possibly with greater effect.

Electronics may enable self-appraisal

Coming back to conventional education in the schools at present, the model of the teacher as coach can help in analyzing some other potential applications of electronic media to the processes of learning and teaching--and to the teaching of learning and the learning of teaching. To the development of a truly interactional theory of these reciprocal processes, the so-called teaching machines have only begun to make their contribution. Essentially the teaching machines all operate by breaking down certain definite types of knowledge into small bits; these are presented in a cumulative sequence to a learner, who is obliged to reproduce them as he acquires them; his progress in learning at each step is instantly confirmed, or his failure to learn is disclosed, so that he is either encouraged to proceed to the next bit or to go back and relearn the previous bit correctly. What is at once evident about the teaching-machine procedure is that its function is to transmit information which is regarded as learned when it can be correctly reproduced.

The teaching machine is not cognizant of special characteristics of the pupil using it. To be sure, he may proceed through the program at his own pace. But the programs of instruction being composed for use in teaching machines apparently aim--insofar as their creators visualize an audience or class of students at all--at a highly-generalized human being. He must of course be literate--all the programs in existence so far require reading (but not writing). If there is to be some selection of content relative to the requirements of particular users, it must be either by students themselves, or by a teacher of conventional type who still retains this function. And obviously the teaching machine as presently conceived attempts none of the functions of the teacher as coach.

Yet why not? Instead of merely disclosing the correct answer after the learner has proffered his, why could not a machine be devised which goes beyond indicating that a mistake was made, to helping the learner discover the specific nature of the mistake? The incorrect answer is the result of something wrong in the process of attention, observation, or cognition that preceded its production. Moreover, there may be several ways of producing the same mistake. Microscopic examination and reexamination of the performance which produces the characteristic mistakes may thus actually give an advantage to the learner in identifying his mistakes by himself, since he alone knows their subjective sides.

Learning the touch method of typing represents a task in acquiring definite knowledge which is amenable to the kind of conditioning employed by teaching machines. The good teacher of typing, however, does not merely point out mistaken copy to the pupil, but endeavors to understand the mistakes in performance which produced the mistaken results. Having identified the characteristic (as against random) mistakes, the pupil is instructed to "practice his mistakes," that is, to repeat carefully those items which are particularly likely to be misperformed by him. By direct observation and discussion with the pupil, plus the wisdom drawn from experience with other makers of similar mistakes, the teacher may ferret out the source of the recurrent failure, and thence act to correct it--if it is correctable. From observing the teacher go through this process of diagnosis of the origins of mistakes, and the subsequent correction, the pupil is thus enabled to diagnose and correct his own failures in performance. That is, he becomes independent of the teacher, not when he has learned to type perfectly, but when he has, through taking the role of the teacher toward himself, become his own further teacher. In view of the basic simplicity of the typing problem itself, and the potential ease of audio-visually recording the typing performance, it seems feasible to invent a series of questions which could be put by a machine to a pupil about the origins of mistakes in his own performance, to supplement or implement microscopic review of performance. The limitations of the present teaching machine, in other words, reflect more the shortcomings of the educational psychology on which it is based than of available mechanical or electronic technology. Both sets of shortcomings, however, once recognized, can to some extent be corrected, but schools, teachers, and fellow-pupils will undoubtedly remain and may even multiply in the future as a further effect of electronic media of communication.

The role of others in learning

Just as the teaching machine omits most functions of the teacher in learning, it also omits the functions of fellow-pupils. Apart from the building and its furniture, a school has always seemed to include not only books and teachers, but fellow-pupils of the learner. The economy of subjecting numerous pupils to the custody of a single teacher, as against leaving education to parents, is obvious. This is, however, not merely an instance of the efficiency of the division of labor, important though such division may be to the professionalization of teaching. In explaining the survival of schools after the advent of printing the function of fellow-pupils in facilitating learning by the individual is at least as important as that of the teacher.

It might be supposed that what other pupils furnish to a learner is simply supplementary to what the teacher furnishes. Older children often teach younger, but it is more important to observe that most, if not all, learning is accompanied with continual reference by the learner to what comparable learners are doing. Such interest seems intrinsic to the learning process, possibly congenital in the species. Animal trainers find that their beasts and birds learn much faster in the company of others, especially those that have already acquired the training that is expected. Few readers would hesitate to apply this analogy to humans. That the presence of others facilitates learning, however, deserves evidence drawn from human behavior.

There are mingled elements of competition and cooperation in this process of continual reference to others. Each human learner seems almost instinctively to match himself with other learners of more or less equal capacity and preparation. Of course among children these tend to be others of their own ages and local origins. Because of the usual differences in their ages, siblings are rarely well-matched peers in learning, so they have to find peers outside their own families. This choosing of comparable learners goes on spontaneously, and is in fact such a powerful tendency that it resists deliberate efforts to extinguish it. Fortunately, the system of grades in American schools accomplishes a crude approximation to such matching. Once schools become large enough, through the growth of population and urbanization, the potentiality exists for refinement of the grading system. So far, however, we have not progressed very far beyond the great reform of introducing eight grades into the one-room schoolhouse of a rural community: now there are twelve grades, but sophisticated experimentation with a view to employing the principles of matching in the facilitation of learning is still rare.

In sports and games, where the sociology of competition is highly developed, matching and handicapping are practiced with great precision by officials. It is also recognized that success in motivating superior performance is dependent on just such precision. When individuals or teams are pitted against inferiors, they become bored and negligent in their performance; when confronted with complete superiors, their motivation suffers equally, from pessimism and discouragement. It is only when resources are equal, and uncertainty as to the outcome depends to a large degree on mobilization of effort, that such effort is abundantly forthcoming. One sometimes wonders how educational theorists could ignore so long the lessons of motivation portrayed by the contrasts between behavior of the same pupils on the playground and in the classroom.

Not everything that looks like competition, however, is actually competition; much of it is emulation. One hopes eventually to equal and surpass his competitor. To do so, he is aided by intensive observation of the other's performance. He tries to acquire decisive advantages in technique, while avoiding disadvantages. With the same aim, he also studies his own performance, ideally with the aid of a perceptive coach who is also skilled in communication. The zest and delight of competition, as the wisdom of experienced players has attested, spring as much from the exercise of highly-developed facility as from the fact of winning. Hence, sports as a human activity represent an elaborate system of cooperation in the maintenance of rules whereby performance is optimized through fair competition. These rules, it should be added, are created and changed by the players, who immediately discern when some previous rule is no longer working to accomplish the objectives of fair and intense competition among equals.

In theory, the system of examinations is a means of measuring absolute proficiency; in practice, it is almost completely relative, that is, it mainly ranks pupils in relation to each other. This observation testifies to the implicit influence of the presence of others on the process of learning. Many teachers accustomed to the present system, if presented with a single pupil and asked to evaluate his performance, would be hard put to do so without reference to the performance of other students.

On the other hand, there are some teachers and theorists who would deprive learners of all benefit of comparison with their fellow-pupils. They discover, of course, that the curiosity of their pupils finds ways to outwit them--to find out the marks of others, for example, or to communicate with each other their own evaluations, which may or may not coincide with the teacher's.

Appraisal of each other's performance is such a powerful and irrepressible feature of most if not all learning that it can be found in all human activity, not merely education. With so many years of life being spent in schooling in American society, the formal methods used in educational institutions also influence other institutions. Evaluations of performance in employment by personnel officers, for example, are often indistinguishable from records kept by school officials. While in industry and commerce the vogue of tests and testing has spread quite widely, it encounters far more resistance and criticism than is common in school systems--and also far more exceptions and evasions, even where officially promulgated.

Numerous other functions emerge from the process of matching by which learning is facilitated initially by fellow-learners. In schools, the system of grading is also a system of pacing. As a framework for scheduling the sequence and duration of the various components of the curriculum, the pace at which all members of a class can keep up with the others will always limit the pace of teaching, short of the point at which each class consists of a single individual. This pacing in turn creates a structure of discipline. In keeping pace with the others, assuming this pace is within his capacity, the learner is governed not only by the commands of the teacher, but by the less formal but often more potent expectations of the others.

Discipline in the working place, as observed repeatedly by sociologists, at least in the sense of rate of production and quality of product, is governed more effectively by the norms of the group than by the demands of supervision. While now and then some highly autonomous individual may exceed the pace of the group and be brought back down to it by their sanctions, and another may be highly productive without benefit of some group standard of comparison, in general it appears to be nearly universal that discipline in this sense is virtually indispensable to productivity. The quantity of effort that is expended in tasks of long duration is far greater than when it is accomplished on a regular schedule, enforced by the expectations and legitimate sanctions of others, than where it depends on the spontaneous volition of the undisciplined individual. Any parent who has ever instructed his own child in almost anything has discovered the value not only of regularity but of involving other children. Similarly, for adult learning regular meetings with a definite program for accomplishment--a definable begining, middle and ending--are almost the sine qua non of all but superficial and sporadic gestures of learning. The field of adult education is sometimes hampered by lack of this kind of discipline. When members of adult education groups become serious about a common objective, however, they are as ready as their teachers to impose such discipline.

These examples of the functions of peers in learning may suffice to demonstrate that neither teaching machines nor any of the other media considered here can take the place of teachers or of fellow-pupils, although electronic reproduction of information might well and usefully take the place of books and printing. The teaching machine in particular, as further experience with it is rapidly disclosing, possesses the defects of its virtues. The boredom it engenders after the first exciting phase of involvement is already widely commented on. The need for teachers and fellow-pupils who can furnish the motivation and discipline for using programmed instruction effectively is now apparent, not least to its serious advocates, who are taking pains to temper some excessive claims of early enthusiasts. The same moderate assessment of their contributions will also apply in observing the evolution of the electronic media.

That the electronic media will no more obviate schools than did printing may seem neither an original nor a very interesting observation. The electronic media are appearing on the scene, however, just when education is expanding beyond the schools to encompass the adult years, and when the need for recurrent retraining, as a consequence of obsolescence of previous knowledge and skill, is being satisfied by many other institutions for their own personnel. Thus, these new media will influence society at large not only through the schools but through all these other institutions as well. Indeed, these other institutions often seem more avid to apply advanced technology in their internal educational activity than do the conventional schools. Thus, it may be that the principal impact of the newer media on society at large will be less through the schools than through corporations, government agencies, professional societies, and commercial organizations. Schools will not be obviated, but may thereby be reduced to secondary importance in the total picture of education.

It could be argued that by the time he becomes an adult, a person can dispense with teachers, through becoming his own guide in what to study and his own coach through electronic self-observation. Once the role of others in motivating learning is fully taken into account, however, it is harder to argue that fellow-pupils become less valuable as the person grows older. The value of the electronic media in respect to fellow-pupils is thus not in obviating them, but in making them more available. That is, the newer media assist in bringing anyone into fuller and more frequent communication with those peers who must closely match himself, who are experiencing similar developmental tasks at the same time.

An excellent example of this pattern of evolution is the growth of specialized professional societies, which bring intellectual peers together in conferences. Some specialties are so abstruse that an international conference of their practitioners assembles only a dozen people. International conferences are so expensive and awkward as to be rarities in the careers of most; hence, cheaper and easier conversation without travel--in place of correspondence and publication--will greatly facilitate such meetings of minds. A far more widespread example of electronic facilitation of communication is the conference call which permits group conversation among teen-agers who are notoriously avid for the company of peers. Teen-agers, not only in America, but in most countries of the world have taken to lengthy group conversations by telephone as rapidly and comfortably as if it were a medium provided by nature. (Although the telephone was invented in the nineteenth century, it deserves inclusion among the newer media, not only for the technical reason that it is thoroughly electronic, but because of its instantaneity and all the other features it shares with radio, television, tape recorder, computer and comsat.) Any instrument which increases the speed and range of communication thus can be seen, through these and other readily-summoned examples, to furnish the developing individual with a larger and more closely sympathetic body of peers. The paradoxical dual impact of the newer media on society--the simultaneous heightening of the importance of the individual and of the international audience--can in turn be seen as in fact a single process: heightened availability of communication necessitates heightened selectivity, and the development of standards for selection of experience is virtually synonymous with the development of the individual.

From scarcity to selectivity

Quantitative effects of technical improvements often have qualitative effects for individuals, which in turn are reflected as vast social and cultural changes far removed from the original technical changes. Printing increased the availability of knowledge to the common man, and thereby released a train of effects far removed from technology. Printing is often evaluated by historians, for example, as a major factor in causing the Protestant Reformation in Europe, because it put the Bible into the hands of every man who wished to ponder his own interpretation of its meaning and application. Television likewise has brought interviews with statesmen into every living room, where their answers are subjected to the critical scrutiny of millions. On topics of current interest pupils may thereby possess as much information as their teachers and be less receptive to their teachers' views. In sheer accessibility, knowledge keeps moving from the status of monopoly toward that of commonwealth. Restrictions on its possession become by contrast more and more the results of rate and extent of learning, rather than of accessibility; the role of the teacher, less that of dispensing knowledge than of stimulating its appropriation.

The leveling of limitations on the acquisition of knowledge magnifies problems of choice for the consumer. He must decide what is most worth knowing. Since life is too short for him to learn everything, he must judge what is most valuable to him in particular. The only justifiably standardized educational curriculum in this sense contains only those kinds of knowledge which are necessary to the process of learning itself, plus perhaps those concerned with the duties of citizenship--which are in a sense tools also, for living together in an interdependent world possessing a vast commonwealth of knowledge.

From the standpoint of the individual, his need for stricter evaluation of the knowledge he should spend his time in learning does not necessarily mean comfort, although it is immensely preferable to cultural poverty. As in the spectacle of the nouveaux riches, who at first buy indiscriminately everything that appeals to their fancy, those exposed to a bigger treasury of knowledge than they can assimilate often try first to increase their rate of intake. Courses in rapid reading, resort to abstracts, condensations and bibliographies, subjective struggles to "keep up with the literature"--these are efforts to raise digestion to the level of the appetite. But like the freshman in college who learns that he must forego most of the courses in the catalogue, however attractive, one eventually learns that one must discipline oneself to be selective according to self-conscious standards. Otherwise intake of knowledge will be neither appropriate nor proportionate to the uses for which it is sought.

The effect of millions of learners seeking to identify the knowledge most suitable to their purposes has a wide range of institutional consequences. These include the development of multiple reference schemes, aids in selection, and more efficient storage devices:

1. The vast array of conventional library reference guides, catalogues, indexes, bibliographies, directories, abstracts, and filing systems.

2. Critical reviews: book reviews, annual reviews of published articles, periodical columns, prizes and citations, even textbooks themselves.

3. Labor-saving and space-saving devices: microfilm, encyclopediae, operations research for putting most-used materials nearest at hand; computerization of bibliographical searches.

It used to be that a library was judged primarily by its size, the sheer number of volumes it contained being the measure usually cited. While the breadth and depth of its resouces remain important, the value of a large modern library today is often limited, not by lack of adequate coverage of a subject, but by difficulty in using these resources. The availability of knowledge is self-expanding. The expansion of the literate classes has led to the expansion of the production of literature of every kind, through schools and scholars, scientists and laboratories, the arts, and all the newer media for their recording and reproduction. The World's Fair project director of the American Library Association now envisages an electronic hookup of all major libraries in a single system for instantaneous exchange of knowledge, whereby each could in the future offer resources of knowledge much greater than now enjoyed even by the Library of Congress. What this means is that the library would become a huge mechanism for identifying what is wanted, then reproducing it from a central source for reading or playing back, rather than being a stack of books as now. Correspondingly, the librarian of the future would become what he has always been without realizing its full implications, an expert in the storage of information and its efficient retrieval.

The technology of information storage and retrieval, while it is galloping forward faster than librarians can keep up with it, remains just that, mechanisms for finding what is wanted, through previous systematic storing according to categories of what is likely to be wanted. No doubt some productive insights on the structure of knowledge will be forthcoming from practical problem-solving in storing knowledge. But in general the librarians will not help the individual decide for himself what is most worth knowing.

If anything, they will work to aggravate the pressure on the individual engendered by the rising availability of knowledge. Against this flood the individual's only defense is selectivity. And this selectivity itself thus becomes the most important continuing product of education in its broadest and deepest senses.

Parenthetically, the heightened availability of information of every kind through the electronic media has not merely made the problem of selectivity more urgent, but has made conspicuous one of the major shortcomings of the electronic media as compared with printing. This is the current inability of the user of electronic media to scan and select or repeat segments of a program or record, as he can with printed matter. The phonograph record or tape recording can be replayed, but at present particular segments on it can be found only with difficulty, and much time can be spent hearing or viewing unwanted material. Some innovative effort is going toward correcting this shortcoming, but it will not yield readily. The format of a newspaper, for example, efficiently implements rapid scanning; it will be many years before broadcast news can be as efficiently scanned. Reading, furthermore, will probably always proceed far more rapidly than the human voice. Hence, some combination of print and sound will no doubt represent a more satisfactory synthesis than trying to obviate literacy altogether.

In addition to the problem of conserving time through scanning, the matter of repetition has immense importance for both learning and the development of the individual. Repetition of information helps memory, but is also of basic importance in what the psychologist Piaget calls assimilation of experience to the self. Closely related to actual repetition as in the rereading of pregnant passages of a book, is the need for interruption for internal rehearsal, review and the making of associations between new material and material already in mind. Without this process of assimilation, the development of standards of relevance and importance is hampered. The relentless flow of content through the electronic media may thus be said to hamper the growth of autonomy of the self, unless it is deliberately compensated for. But again, the electronic media themselves help to precipitate awareness of this need, which existed before they were invented although not to the same degree.

Finally, the increased availability of information through the electronic media has likewise made far more salient than ever before the realization that education cannot stop with formal schooling, but must permeate the whole of life if the individual is not to be cast aside by the course of events. This is not a new idea, but the reform of all institutions to facilitate the continuous development of their personnel is hardly recognized as their most urgent task, much less earnestly begun.

The concept of career

The idea that education does not cease with graduation from a school goes back at least to Epictetus who wrote:

> Education, in the deepest sense, is continuous and lifelong. In essence it is unfinishable. What we think we already know is often less helpful than the desire to learn.

Nonetheless, even in the United States, which enjoys higher per capital wealth than anywhere else on the globe, we are far from achieving generally a state of affairs in which education is continuous and lifelong for every citizen. When that time comes, it will not consist simply of a state of affairs in which adults of all ages are enrolled in what now pass as adult education courses. A tremendous transformation of the social order will have occurred.

At the present time most occupations are not defined as professions, and most jobs are not viewed as careers. But the career is the vocational manifestation of continuous, lifelong education, and vice versa. Adult education at present consists largely of either the acquisition of supplementary vocational training of very specialized kinds, or the acquisition of supplementary avocational skills not too seriously pursued. Neither kind is addressed to the central concern of adult existence, what to become. It seems unnecessary nowadays to remind anyone that the question of what to become is no longer answerable once and for all at the beginning of adulthood. It may have been a necessity or a privilege only for the few in the past to reformulate their identities repeatedly throughout adulthood; henceforth it will be the necessity or the privilege of the many. But whether it will be a privilege or a necessity for any specific individual will be determined by whether his education makes him equal to the challenge of designing his own career and guiding its development.

The heightened availability of knowledge provided by the newer media contributes to the necessity for choice of what to become, and provides--as already sketched--greatly improved means for self-conscious appraisal of one's own performance, actual or potential, hence higher standards for selection of further experience. These are individual responses to the multiplication of alternatives. When many individuals are concertedly in process of becoming more selective, the long-run collective effect of their intensified discrimination is a general upgrading. For example, television-viewing at present has declined from its peak of several years ago in average hours per week per person, and has declined even more among the better-educated. In order to lure back this more desirable segment of their audience and prevent further deterioration, broadcasters either have to elevate the quality of their present mass programs or create specialized programs for this segment. Some are doing the former, some the latter. Given a general trend toward more discriminating markets and audiences, competition among purveyors of cultural fare ultimately causes the good to drive out the bad, short-run appearances to the contrary notwithstanding. For many years--probably ever since the invention of printing--it has been fashionable among aristocratic critics to decry the mass media which have made cultural fare more available to masses of people, on the grounds that somehow this was leading to debasement of culture in general. If the sales of paperback books are taken as an example, it is difficult to see what these critics could use as evidence that greater availability has debased the taste or knowledge of anyone. The evidence instead seems all in the other direction.

It has long been noted by adult educators that adults have to be dealt with differently as pupils than do children. Apart from the fact that adults are bound by no compulsory attendance laws, adults are highly discriminating in their judgements of the relevance of content and of the performance of teachers. While there is a fringe of participants in adult education courses who take them only to kill time, assuage loneliness, or be lightly entertained, the main incentives are usually serious vocational objectives, or equally serious efforts to acquire expert amateur status in avocations. Hence, adult pupils are demanding in their standards, and, since much adult education is unsubsidized, while attendance is voluntary, the course which patrons shun is quickly terminated. In other words, divorced from formal schoools, education must pass a rigorous market test. In the past, education conducted in schools has rarely been forced to meet this market test, either internally, as among course offerings, or externally, as among competing schools. The shortcomings have been sheltered by the local monopoly status, which has simultaneously made them inevitably the target of controversy.

During recent decades, however, it has been evident that other media have been able to compete successfully with the schools more and more frequently. Lecturers on current events, travelers from foreign lands, authors and critics, to illustrate, appear frequently on television and radio and make the ordinary teachers of social studies or literature seem quite amateurish by comparison. As yet the efforts to develop what is called educational television have not been notably successful financially. Nonetheless, it is evident that when any kind of educational offering develops a large and avid audience, it quickly gets commercialized. The success of _Life_'s science books have been as spectacular as such television programs as _Ding Dong School_, _College Bowl_, and _Meet the Press_. If the cost of television broadcasting can be reduced to something near the cost of FM broadcasting, the potentiality for much more strenuous competition between commercial media and the schools emerges. At that point, not only will the newer media set a challenging standard for conventional patterns of adult education, but the pressure will be felt on children's education as well. Who would want to go to school and be miserable if he could stay at home, learn as much or more just as fast, and enjoy himself as well?

The questions which would remain if the newer media thus succeeded in driving out bad teaching would be those with which this essay began, whether schools and teachers and fellow-pupils would be obviated. Again, the answer to this question, although qualified, would still be "no." Schools and teachers and fellow-pupils would still have important functions to contribute to learning, but to these would be added a basically more enjoyable presentation of material to be learned.

Education and entertainment have long been treated as separate categories of experience, despite the efforts of philosophers and psychologists to make clear that learning can be enjoyable. It may be that the most revolutionary consequence of the greater availability of learning made possible by the newer media will be to demonstrate universally that learning never has to be painful, that good teaching can be as enjoyable as the best entertainment. From the standpoint of the learner, given a choice between learning that is enjoyable and learning that is not, it is not likely that inherited beliefs would stand in the way of enjoyment.

Insofar as schools lost their local monopoly status through competition with commercial media, they would also lose much of their basis for controversy over curricula, architecture, and student conduct. Those who differ could go elsewhere; education would become as free as book publishing.

Theories of audience and performance

It is characteristic of human thinking to make initial distinctions in simple polarities like mass versus individual, but with increasing sophistication to complicate these distinctions. Thus, instead of pursuing fruitless arguments over the values of mass and class, the impact of the newer media on culture in general can better be approached through systematic discrimination of types and sizes of audience in relation to kinds of performance presented. A classic, for example, seems to be addressed to men of all times and places, yet only a small elite of any particular time and place seem able to recognize a classic. High school sophomores who are told that Shakespeare is great may remain dumbfounded by The Merchant of Venice. On the other hand, almost any American viewer, literate or otherwise, can appreciate the humor of Bob Hope--even though the next generation characteristically sees nothing funny in the humor of its predecessors. Perhaps the confusion about the effect of mass media in creating mass culture can be clarified to some extent by distinguishing between availability and accessibility. The Merchant of Venice can be made more available through television than through legitimate stage performance, but it does not thereby become any more accessible to the minds of viewers and listeners. Mass culture in the sense of universal recognition of Bob Hope's quips may take the place of provincial culture, with perhaps some loss of local variety but probably no loss of quality. In fact, his humor is likely to drive out worse humor, although the difference need be only marginal to be competitively successful. On the other hand, whenever or wherever a person exists who can appreciate Shakespeare, his level of culture is elevated by increased availability of Shakespeare. Shakespeare may not as yet be successful commercially on television, yet if complete video recordings of The Merchant of Venice, performed by the greatest actors, were as available as paperback copies of the text, it is certain that the elevating influence on the average cultural level of contemporary entertainment would be appreciable. And the bigger audiences so developed might finally make it commercially quite profitable.

Before contemporary methods for reproducing dramatic performances were invented, actors could perform various dramas thousands of times before face-to-face audiences, yet millions of people could live their whole lives without a single opportunity to witness a performance. While complaints are frequent about the shortcomings of mechanical reproduction, it is less common but far more appropriate to complain of the stultifying effect upon both performers and audiences (and teachers and learners) of excessive repetitions by performers. This is the really intolerable mechanical aspect of repetition, not the manifold mechanical reproductions of a single superb performance. With both moving pictures and television available, the Broadway actor can escape a role he otherwise has to perform hundreds of times. Before the newer media, he could not make a living without numerous repetitions of a limited repertoire.

In both entertainment and education, stimulation and stultification are decisively important values in determining and judging results. So much stimulation comes from doing new things, so much stultification from inordinate repetition, that the familiar prejudice that mass reproduction deteriorates culture gets virtually reversed by close examination. There are many remaining situations in both education and entertainment where people still suffer stultification which could be alleviated by further use of the newer media. On the other hand, there are many situations where more face-to-face interaction between teacher and learner, performer and audience, is in order if education and entertainment are to be improved.

Out of professional thinking about these matters is therefore likely to come a much higher degree of self-consciousness as to which audiences are appropriate for which performances. In the teaching of languages, for example, it is important for the learner to be his own audience--hear his own voice--and the electronic language laboratory now makes this possible. He could always hear his teacher's voice and the teacher, his. At the other extreme, at a moment of national crisis, it is possible for the whole nation to hear the voice of a single leader simultaneously, whether its citizens are at work or at home, on the road or in the air. Between these extremes, however, many discrepancies occur between performance and appropriate audience. People are forced to listen to speeches who might better read the information they contain. Television and radio performers crave for contact with audiences; writers create for publics which do not exist. Manual training in the operation of equipment--highly suited to automated instruction--is still taught mainly be apprenticeship--the most expensive and least effective of all methods, one incompetent teacher per pupil, i.e., instructors versed in the equipment but not in the art of teaching. Practice-teaching itself, under the eye of a supervisor, is probably obsolete in the presence of the newer media. Not only do the newer media permit the student-teacher to view his own performance, but for many other learners to view it simultaneously on film or tape, and to discuss it more fully and discriminatingly and objectively than any single observer could, with the learner able to hear such criticism while choosing to be present or absent.

A minor feature of this interaction, but one of immense importance in the general economy, is the previously-noted bearing of communication on transportation and the housing of such interaction. How many meetings are held, the objectives of which will be more cheaply, swiftly, and effectively achieved when the public finally acquires the habit of using conference telephone hookups? Conversely, how much money is spent on advertising to convey messages of interest only to a few, who can nowadays be located by contemporary information systems and then be reached individually? Communication habits which presume traditional social relations have not changed as rapidly as communications technology has evolved. Could any procedure for the exchange of relevant and wanted information be more awkward than the means by which strangers somehow become acquainted in large cities? The sociologist himself has hardly begun to define this as a problem, much less to apply the newer media to its practical solution. Village marriage brokers did better in this respect. Yet the newer media evoke a host of such opportunities for relating individuals and larger audiences in ways which will modify previous patterns of association and activity in unimaginable ways.

The global audience

In contemplating the effect of the newer media on the definitions of appropriate audiences in the future, it is apparent that just as they bring the individual as an audience of his own performance into view as never before in history, they also bring into view the potentiality of the entire world as an audience as never before in history. Indeed, the most exciting potential impact of these media on human communication is in the impetus they add to the ancient hope of a common international language. The very availability of the opportunity to converse with people in other lands characteristically encourages assimilation of language, as the long chronicles of warfare and conquest, trade and missionary activity disclose. Writing characteristically tends to stabilize and perpetuate language differences. Latin writings persist after the spoken language has disappeared, for example. By contrast, conversation continuously alters language, so that new words and phrases appear and old ones disappear, especially in border areas. The newer media foster diffusion of language, as of other cultural elements, without the necessity of migration. The United Nations could not transact its business at present without electronic methods for simultaneous translation--but the very existence of these electronic methods contributes to the rapid learning of common languages which will ultimately obviate simultaneous translation. The ultimate horizon of a universal language so induced--an electronic esperanto--will not be reached in this or the next generation, but movement toward it is sufficiently rapid as to be visible--especially among scientists--within just the period since World War II (and, deep in one's heart one may hope, perhaps fast enough to avert World War III).

In the so-called underdeveloped countries, it has become standard practice for people to leapfrog the technological history of countries like our own, to change, for example, from oxcart to airplane in a single generation, from leg power to nuclear power, without going through an age of coal and steam. Bolivian Indians fresh from the jungle have been trained as airplane mechanics through use of sound films, without ever learning to read more than simple markings on parts. It is therefore imaginable that members of primitive tribes will learn to speak an international language with people from anywhere else without having to learn to read and write any so-called written language. As soon as the ideal communications satellite is established in orbit (or in stationary position in space, whatever that means) and non-jammable global broadcasting becomes thereby feasible, local governments and nostalgic curators of the past will no longer be able to resist the tendencies toward an extremely small number of global languages. For governments deliberately seeking to eradicate a troublesome profusion of local dialects, such technology is an ideal instrument. The electrical engineers who have already joined with statistically-minded analytical linguists to invent computer-type electronic translators are hastening the process with all the direct rationality of applied science already. It may be that the time required to develop an electronic esperanto will prove overestimated at more than a generation, since only a single generation is required to produce a complete dissociation between parents and children.

Conclusion

It is often charged against radio and television that the nonliterate spend the most time using them. By one of the frequent ironies of history, it may be thus that the nonliterate become the first to acquire the new global language that is in gestation. In noting this irony, we come back to our basic analogy between the impact of printing on society and the impact of the newer electronic media. We can now ask, for example, if the newer media will have more effect on the more literate or the less literate.

It has been generally observed that the higher the level of education people possess, the more likely they are to engage in self-educational activities. College graduates study more in later life than people with only primary schooling. For them the newer media may thus appeal most strongly as a unique means for further development of their own performances, whatever their vocations or avocations. For the illiterate members of primitive tribes, at the other extreme, these new means of hearing vastly expedite their entry into world civilization, whether through learning to practice agriculture as our ancestors did in Neolithic times, or to preach neutralism at some world conference. So viewed, it becomes obvious that the newer media bring both literate and illiterate so much closer together in their power to affect events that the question of which has been moved the furthest becomes unimportant. Even for the literate, learning has not hitherto been painless; if education and entertainment become progressively indistinguishable, such a question as whether audio and video electronics are any less appropriate to education than books and printing are to show business becomes academic. Such a question will probably cease to be asked once the newer media are demonstrated to furnish the ideal method, in the hands of a good teacher, in a class of well-matched pupils, for teaching and learning reading and writing--literacy itself. Boiled down to their essentials once more, reading and writing are means for converting auditory into visual information and back again, with considerable impoverishment in the process. Electronic audio-visual recording, transmission, and reproduction convey information unchanged from its original (save by remaining mechanical infidelity), while immensely lengthening its reach in time and space.

The sequence of inventions which have led to the present question of the impact of the newer media on education and society can be construed as moving, like all inventions, in the general direction of extending human capabilities: the sensory functions of seeing and hearing, the mental functions of memory and recall, the physical functions of speech and movement. In the beginning, it might be said, each advance in some particular direction was accomplished at the sacrifice of some other function, sometimes, indeed, at the cost of added awkwardness and complication. It was a good advance in communication to invent a telegraph that could transmit messages instantaneously beyond the reach of either sight or sound. Thenceforth information could be communicated across space without requiring physical transportation of the paper on which it was written or printed. But the telegraph forced translation of auditory information into the visual form of letters and words in another coded language, and also required the training of specialists to do the coding and decoding. The telephone by contrast obviates both steps, making conversation at a distance between two persons almost the equivalent of face-to-face speaking and hearing. The application of television to telephoning is already here, in the form of closed-circuit televising of surgical operations, underwater explorations, and the holding of large conferences simultaneously in several rooms or even more dispersed places. As in all technology, the course of evolution of separate inventions for communication is thus toward synthesis and simplification, as well as toward the addition of further improvements. In respect to communication in particular, communication at a distance in space has now become almost identical in quality with conversation face-to-face. But meanwhile other improvements have been added which not merely equal the quality of the original, but go far beyond it in extending human capabilities quantitatively.

Some of the improvements of communication which go beyond mere fidelity in transmission over a distance are these:

1. Larger size of audience through amplification,
2. Dispersal of audience in numerous places,
3. Simultaneous recording as well as transmission,
4. Simultaneous visual feedback to the performer,
5. Automatic, instantaneous sampling of large audience reactions (i.e., mass munication is becoming mass communication, thus eventually obviating the laborious current procedures of audience research).

The current high costs of some of these improvements may, perhaps permissibly, be ignored here, since another conspicuous feature of technological trends is the drastic reduction of costs. After invention of the first successful video-tape recorder, the first manufactured model sold at close to two hundred thousand dollars per unit. A simplified model using standard audio-tape is now expected to sell at less than two hundred dollars, i.e., in the same price range as audio-tape recorders. So it is reasonable to anticipate that not merely broadcasting studios, or well-to-do educational institutions, can afford the latest inventions for audio-visual communications, but the ordinary individual consumer also. For this consumer, a built-in tape deck in his receiver, timed to record his favorite programs whenever they are broadcast, can be played back at his leisure. He is thus delivered from the tyranny of broadcast scheduling. Moreover, ultimately he may also be delivered from the tyranny of the sponsor who selects the content which will be broadcast. If the so-called educational stations were to constitute themselves as libraries of notable past performances, and would broadcast these with high fidelity for home reception and recording, each member of the audience could rapidly accumulate the basis for attaining complete sovereignty over his cultural fare. Indeed, such an unlimited library of recorded performances of every description, any of which may be replayable at leisure has already been dubbed a "culture machine" by J. B. McKitterick of the General Electric Company.

It is premature to imagine whether the home could or would become itself the repository of the cultural wealth of the world. Perhaps the home would instead simply be connected by wire with a regional library, as with a local telephone exchange, which could be dialed for any information or performances in its catalogue, not burdening the home with ownership or storage.

It is not premature, however, to imagine that the home will presently be conceived as a center for reception and assimilation of learning and new experience, and its electronic equipment will more and more be organized as a complete system, designed for education as well as entertainment. Although a connected system, there is much evidence in trends of circuitry and design that it will consist of compatible, replaceable modules--receivers, recorders, players, automatic timers, amplifiers, mixers, stereo-cameras, stereo-microphones, tuners and dialers, random-access tape files, stereo-speakers and stereo-projectors. It is perhaps a minor consequence of no great relevance here, but the householder is tempted to ponder the day when the advance of erasable tape eliminates much of the printed paper which clutters his mailbox, home, office, and school.

Magnetic tape, like printing, was invented by the Germans. The Army Signal Corps brought captured samples to the United States during World War II, and the industry flourished so rapidly that the previous technique of wire recording was quickly abandoned. Technologists in many countries--England, Scandinavia, Italy, Japan, Russia, even India--are working so intensively to develop tape technology that any confident forecasts of what inventions lie ahead would be foolhardy. Perhaps tape itself will be superseded by a superior recording medium before it can supersede phonograph records or movie film. (In dollar volume, phonograph records already outsell all trade books published in the United States; tapes may before long outsell all textbooks.)

Regardless of the headlong pace in development of diverse technologies in all functions of communication--recording, transmitting, reproducing, and the like--the ideal toward which they move will remain fidelity in seeing and hearing at a distance in time or space. That is, these functions may be simulated by technical means up to the fidelity of human perception itself, but that will be the limit of their practical development. There are uses for ultrasonic frequencies, for example, but not for human hearing, for infrared light, but not for human seeing. Hence, it is possible to think productively about the social effects of improved communication without being able to foresee all the inventions by which human seeing and hearing may be extended in time and space.

Is it too much to conclude that the newer media potentially connect the individual learner with any available knowledge in the world of past or present? In this sense, the goal of education--the ultimate development of the individual--is joined with the ultimate goal of communication--the unification of human society.